FLIGHT

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Apl. 12 .... "Some Aspects of the Development of the Slot." Mr. G. R. Volkert, before R.Ae.S. & Inst.Ae.E.
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May 28 .... Light 'Plane Meeting, Hamble

EDITORIAL COMMENT

The Pity of it

ON Friday of last week, March 23, *The Daily Mail* contained an interview with the Secretary-General of the Air League of the British Empire, Brigadier-General P. R. C. Groves, which we do not feel that we can, in justice to British aircraft designers and to the British public, let pass unchallenged. The *Daily Mail* has such influence with the million through its enormous circulation, and has in the past done so much to further the cause of aviation, that one must regret to see it publish aviation news of the character of this interview, the position of the "interviewed" being such that an importance is likely to be attached to his reported statements far in excess of that which, in this instance, they merit.

The interview to which we refer relates to a new "giant" flying-boat of which "the intelligence section of the Air League of the British Empire has secured the first authentic details." The interview proceeds to state that this machine is under construction in the works of the German Dornier Company on the Swiss side of Lake Constance, and that "The craft, which is a flying-boat, inaugurates a new phase in aircraft design. . . ." General Groves is quoted as stating that the new machine will have a wing span of 158 ft., a total loaded weight of 44 tons, 12 engines developing a total of 6,000 h.p., and will carry 50 passengers and a crew of nine. Furthermore, the machine, it is stated, is intended for a German service across the Atlantic to New York.

Taking the figures quoted to be accurate, and we have seen no statement from General Groves to the effect that he has been inaccurately reported, the wing span of this new monster is to be 158 ft. A fairly common aspect ratio for normal wings is 10. This would make the chord of the Dornier 15·8 ft. For simplicity, let it be assumed that the chord is 16 ft. In that case the wing area would be 2,530 sq. ft., and as the machine is reported to weigh 44 tons (*i.e.*, 98,560 lb.), the wing loading would be 39 lb. per sq. ft. In other words, it would be an impossibility for the machine to get off the water!

Even if we assume that the aspect ratio is only 6, the wing loading would still be 23·7 lb./sq. ft., and since, as Mr. C. C. Walker has pointed out in FLIGHT, "chord is no cure for an overloaded machine but span is," the flying-boat would not even get off with this loading. Another way of saying the same thing is to state that the ratio span^2/weight would be as low as 0·253, which would give a very high induced drag at low speeds.

It may be, of course, that the figure for span has been wrongly quoted. It can be shown, however, that even so, on the remaining figures given, the machine cannot possibly accomplish the flight across the Atlantic. Taking a crew of nine and 50 passengers and assuming for them an average weight of 160 lb., the "live" load would be 9,440 lb. Luggage and/or food would at least bring this weight up to 10,000 lb. If we assume that the power plant weighs, with engine mountings, cowlings, etc., 3 lb. per horse-power, a reasonable figure, the 12 engines will weigh 18,000 lb. In order to be able to contemplate the Atlantic crossing, fuel for at least 36 hours will have to be carried. Even taking the most favourable view and assuming that the machine will, once it is in the air, fly on 60 per cent. of its full power, *i.e.*, on 3,600 h.p., and assuming that the petrol consumption is as low as 0·5 lb./h.p./h., the consumption will be 1,800 lb. per hour, and for 36 hours the weight of petrol would be 64,800 lb. The petrol, engines, passengers and crew would then weigh a total of 92,000 lb. As the loaded weight is stated to be 98,560 lb., there would only remain a weight of 6,560 lb. for the machine itself. This would correspond to 6·65 per cent. of the total loaded weight. In fact, the petrol tanks would probably weigh about that, so that the machine itself would weigh nothing! Truly, as the interview has it, the new machine does "inaugurate a new phase in aircraft design."

It seems a great pity that a man in the position of General Groves should permit himself to be quoted without having obtained some technical opinion on his subject matter. The "intelligence (!) section" of the Air League, so far from having "secured the first authentic details," appears to have secured a gigantic "leg pull." And then there are people who will tell one that the Germans have no sense of humour!

But for the fact that the penultimate paragraph of the interview may easily cause the man in the street to think that British designers are a long way behind the Germans, we should not have troubled to devote space to this matter. But the circulation of the newspaper in which the interview was published, and the status of General Groves, makes it desirable that the actual position should be made clear. The last paragraph but one reads as follows: "The question now arises, is Britain to be left behind also in the coming international competition for trans-ocean air traffic? For such work very large multi-engined flying-boats are essential. Our largest existing commercial flying-boat is one of 1,500 h.p., weighing about 9 tons." Compared with the 44 tons quoted for the Dornier, this is a contemptible figure, certainly, but there is some consolation to be derived from the fact that our commercial flying-boat flies!

We shall look forward to seeing the "definite and exclusive information," which is to be published in the April issue of *Air*, the official organ of the Air League. At least no more appropriate month could have been chosen.

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AFGHAN KING OVER LONDON

THE King of Afghanistan flew over London on March 21 in an Armstrong-Siddeley "Argosy," of the Imperial Airways fleet. It was his only flight since visiting Europe, and was one item in the programme during his visit to Croydon aerodrome. He was accompanied by his suite, Sir Samuel Hoare and Air Vice-Marshal Sir Sefton Brancker. The pilot was Capt. W. Rogers, who steered a course for the Crystal Palace, then turned north for the Thames, and crossed London at 2,500 ft., revealing to the King all the well-known buildings and historic sites. Capt. Rogers was presented to him at his request after the landing, and complimented on his skill. An aerial map of London is being prepared for His Majesty by the Aircraft Operating Company in accordance with his wish expressed on seeing the air map in the Air Survey exhibit. It will be marked with a red line tracing the route flown by him over London.

Whilst the Royal party was examining the light aeroplanes drawn up on the aerodrome, Capt. Neville Stack, flying a Nimbus 9, passed above and dropped a mail Potter-McKenna parachute, which fell accurately opposite the King. A postal delivery was made then by Sir Sefton Brancker. The King received a picture postcard of the aerodrome, duly stamped with that day's postmark, and with the blue air mail label. Private owners were represented by Miss W. Spooner, who flew her D.H. "Moth" to the aerodrome, and Miss Brown, who had flown down the previous day from Manchester. Capt. Stack also exhibited the easy handling of a light aeroplane. He ran an Avro "Avian" out of a small hangar with its wings folded, unfolded them, started up and took off—all within a few minutes.

His Majesty made a rapid but complete inspection of Croydon with the greatest interest, and at the conclusion he expressed his appreciation of our development in commercial and private flying.

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Italy's Air Force

THE Under-Secretary for Air in Italy, Signor Balbo, in presenting the Air Estimates, amounting to £7,608,000, stated that Italy possessed 1,800 aircraft, 1,000 of which were in line and the remainder in reserve. In comparison France had 1,940 machines in line and 4,000 in reserve; England, 775 in line and 520 in reserve; and Jugoslavia, 400 in line and 150 in reserve. In 1927 Italy produced 450 machines, and it was hoped to reach a total of 2,600 in the near future.

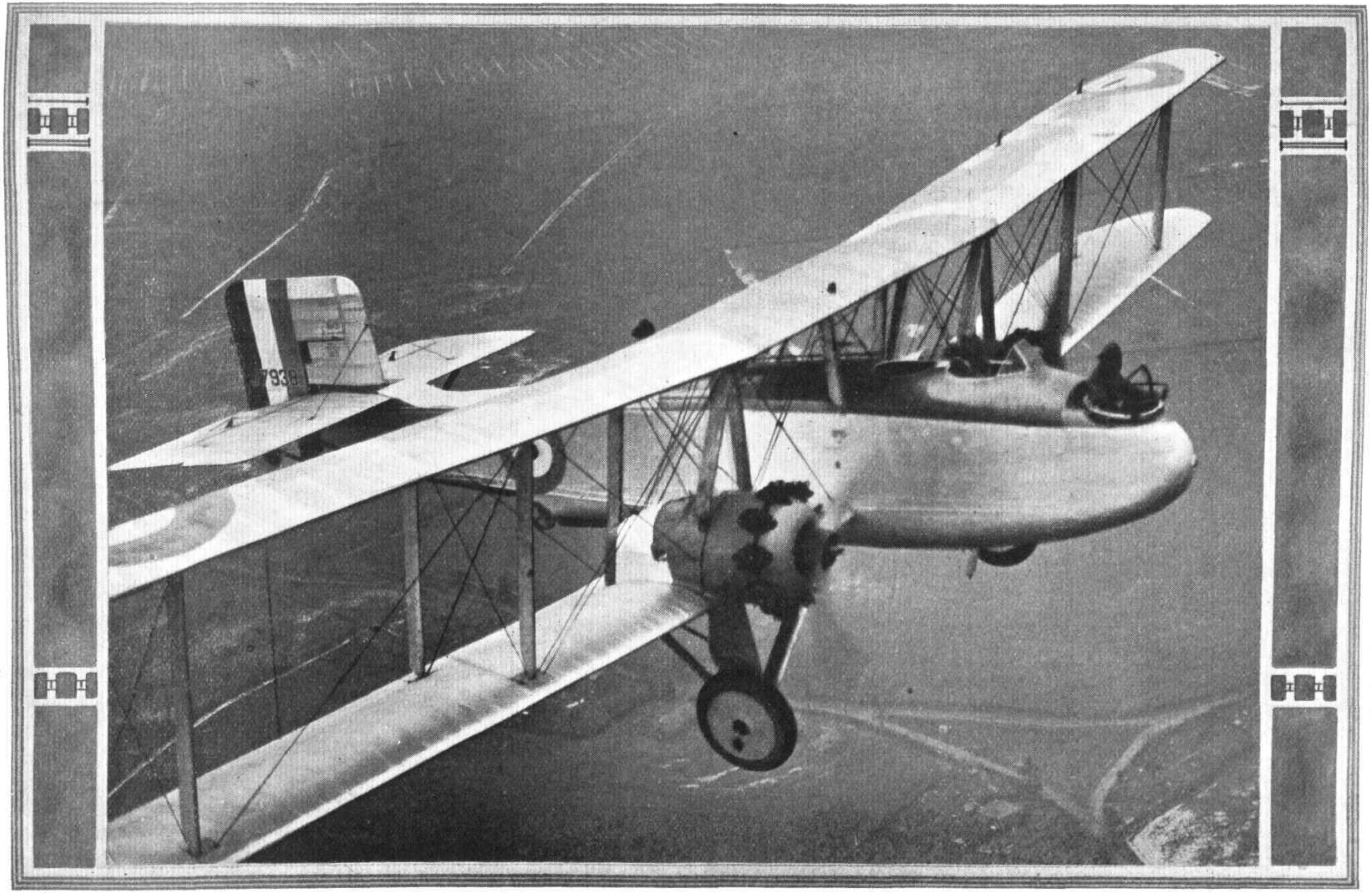
The Paris Aero Show

As previously announced in FLIGHT, it has been decided to hold the Eleventh International Paris Aero Show (in the Grand Palais des Champs-Elysées) this summer, instead of at the end of the year. The opening date will be June 29, and the closing date July 15. Various interesting aviation demonstrations at the several aerodromes situated in the suburbs of Paris will take place during the exhibition, and it is announced that the President of the Republic and other members of the Government will visit the Salon. It may be mentioned that entrance applications should be addressed to le Chambre Syndicale des Industries Aeronautiques, 9, Rue Anatole de la Forge, Paris.

On Records

The Air Ministry issued the following statement on March 26:—

"Reports that the Air Ministry has decided to make an attempt this year to break the world long-distance non-stop flight record are premature. The position is that an aeroplane is being built for the purpose of making an exhaustive test at home to determine how long an engine will run in the air under normal flight conditions. This aeroplane will naturally be a machine which might well beat the present-time duration record. The question of a long-distance flight will only be considered after the tests have been satisfactorily carried out."



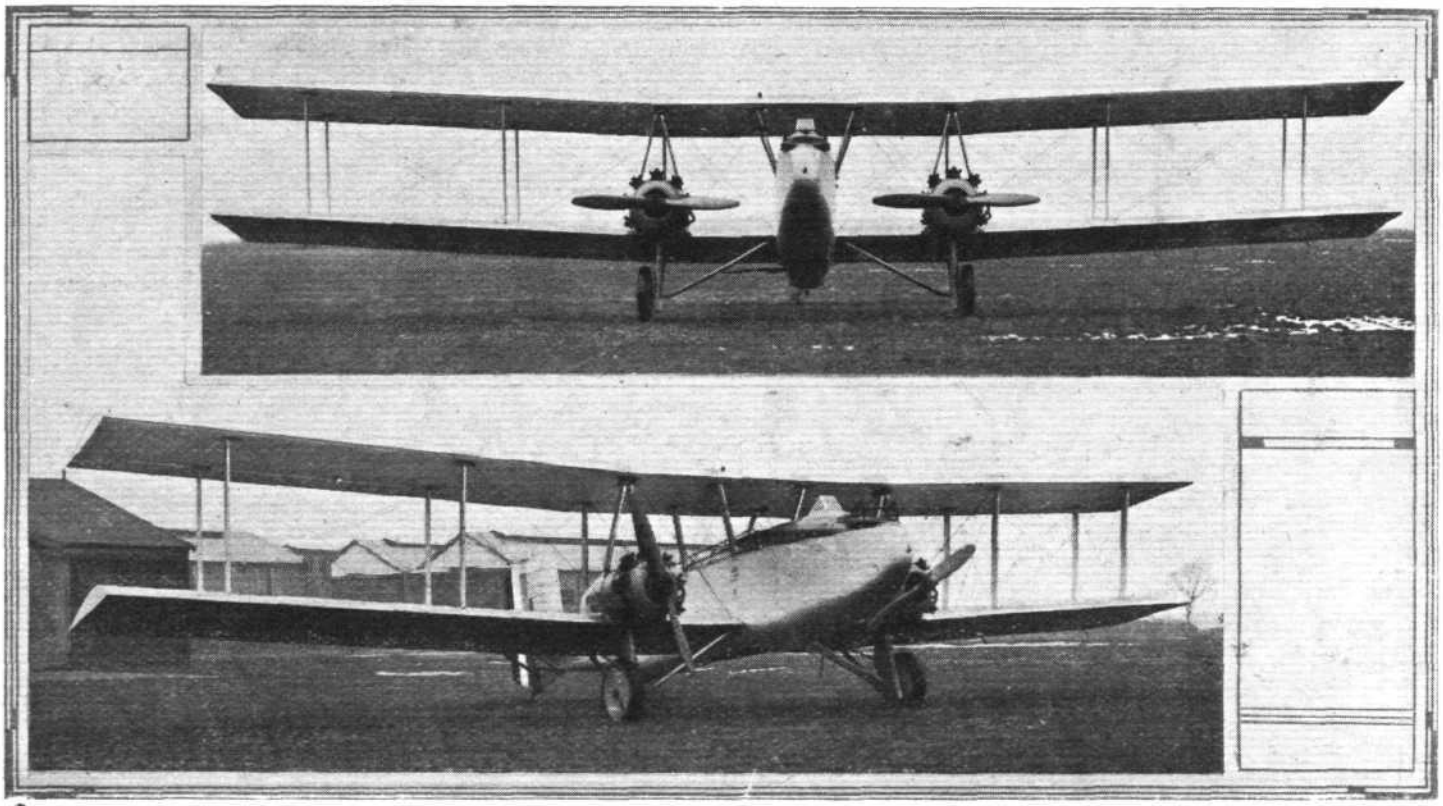
["FLIGHT" *Photograph*

THE BOULTON & PAUL "SIDESTRAND": An aerial view from above, taken from a de Havilland "Moth."

THE BOULTON & PAUL "SIDESTRAND I"

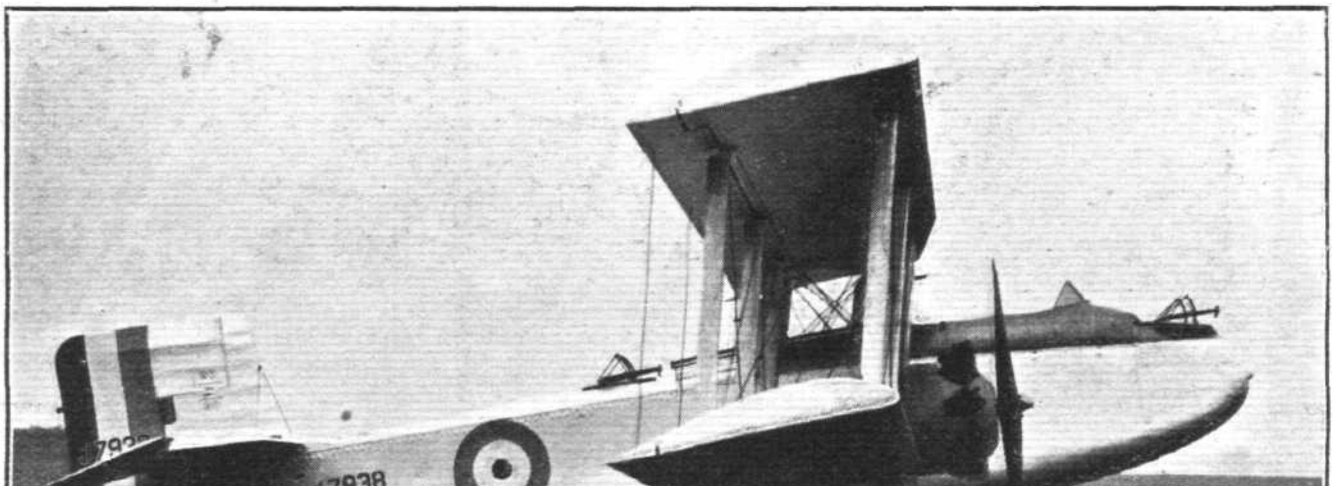
2 Bristol "Jupiter VI" Engines

IN attempting to convey to readers of FLIGHT an adequate idea of the new Boulton & Paul twin-engined bomber which has recently gone into production for the Royal Air Force squadrons, two ways are open: One might concentrate on the merits of the machine (and they are many) for the particular purpose for which it was designed, or one may approach the subject along more general lines, examining the machine as an aircraft pure and simple, with but minor regard to its particular function as a military weapon. In the former case one would merely be describing a machine which is a very excellent bomber, while by taking the alternative approach the merits of it as a piece of aeronautical engineering can be examined. On the whole, we believe that the majority of our readers are likely to be more interested in the general aerodynamic and structural features, and as there are certain restrictions which prevent a full discussion of the military equipment, the following notes will be devoted to the general design of the "Sidestrand," bearing in mind that the machine



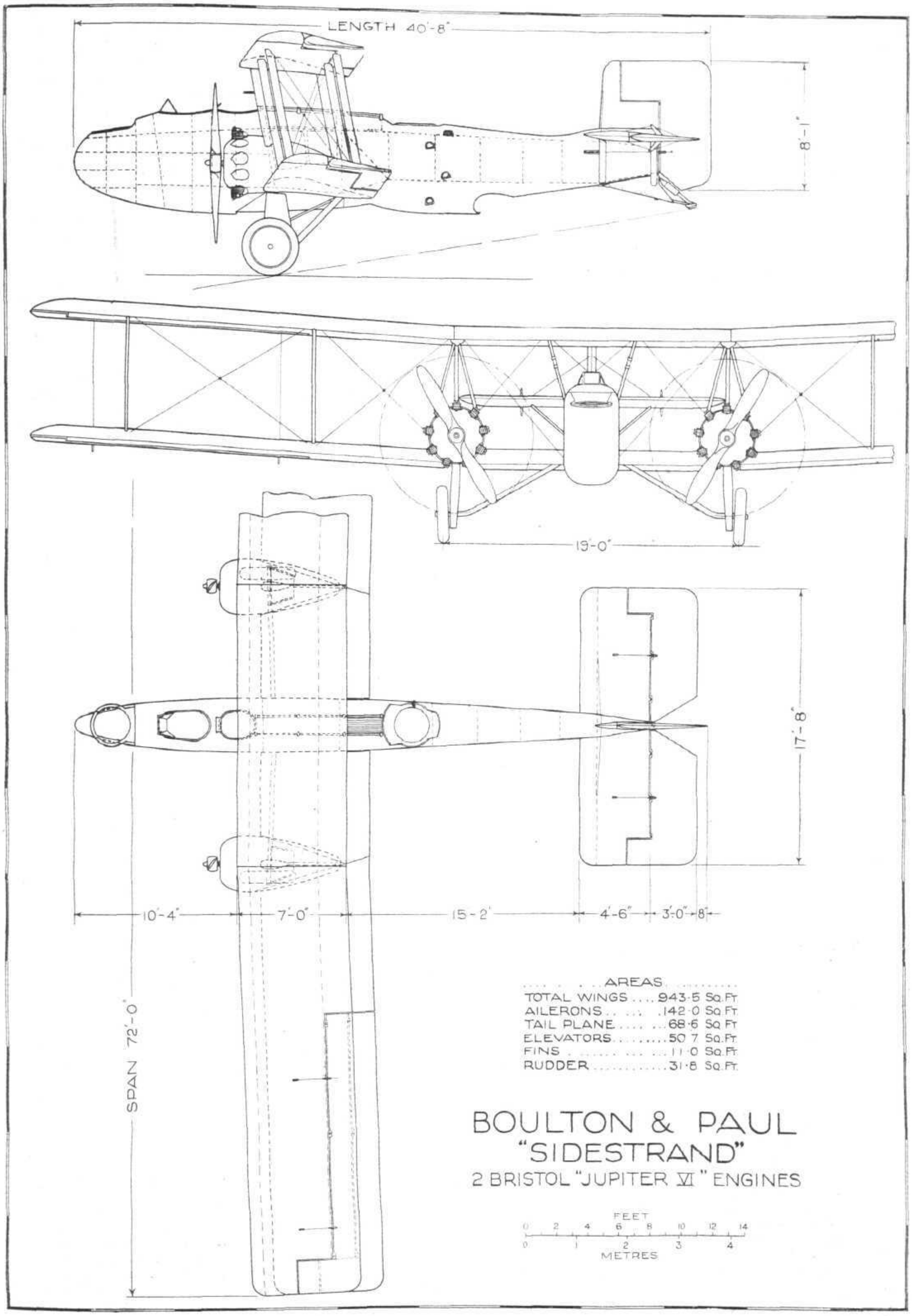
["FLIGHT" Photographs

THE BOULTON & PAUL "SIDESTRAND": Front and three-quarter front views. Large span, and "clean" fuselage and engine nacelles are characteristic features.



["FLIGHT" Photograph

THE BOULTON & PAUL "SIDESTRAND": Side view. Note the three gun positions, and more particularly that for the aft gunner firing under the tail.



THE BOULTON & PAUL "SIDESTRAND I": General Arrangement Drawings, to Scale.

has been designed as a three-seater day bomber, and that therefore certain specified loads had to be carried, loads consisting partly of equipment, partly of machine gun armament, and partly of bombs. What percentage of each is involved we are not in a position to state.

Aerodynamic Design

Those of our readers who have followed his interesting series of articles on "Aircraft Performance" in our monthly technical Supplement THE AIRCRAFT ENGINEER will have obtained a fairly good idea of the general design policy of Mr. J. D. North, Boulton & Paul's Chief Engineer and Designer, and in examining the "Sidestrand" one looks for such features as Mr. North has advocated in his articles. Among these perhaps none was more prominent than the reduction of induced drag by having a high value of the ratio of $\frac{\text{Span}^2}{\text{weight}}$, and a glance at the general arrangement drawings and some of the photographs will show that the "Sidestrand" has a very large span for its area, or, as we used to say before modern aerofoil theory became the fashion, high "aspect ratio." While Mr. North drew attention to the importance of large span, he also pointed out that for large machines it is difficult to obtain a high value of the span²/-wt. ratio because of the increased wing weight which quickly puts a limit to the span which it is economic to employ. In the "Sidestrand," therefore, one may take it that an endeavour has been made to get the best compromise between wing structure weight and aerodynamic efficiency, and it will be of interest to examine briefly how far the wing arrangement of the "Sidestrand" may be expected to have reduced that part of the wing drag which is due, as Mr. C. C. Walker puts it to "carrying a certain weight on a certain span at a certain speed."

The total loaded weight of the "Sidestrand" is 8,850 lb., and the span is 72 ft. The value of $\frac{\text{Span}^2}{\text{W}}$ is therefore 0·518 and the monoplane value of the ratio of lift to induced drag is, at 70 m.p.h. for instance, 20·31. As the gap/span ratio of the "Sidestrand" is about 0·14, this value is increased to 25·9 for the biplane arrangement used. Thus at 70 m.p.h. the induced drag is only 342 lb., which is remarkably low and corresponds to a thrust horse-power of 64 b.h.p. only for overcoming induced drag at that speed. Since at this low speed (corresponding probably fairly well with the climbing speed of the machine) the induced drag is a large percentage of the total wing drag, it is seen that the "high aspect ratio" wing arrangement does appear to have proved extremely beneficent. The span²/weight value of 0·518 is quite high for a machine of this weight, and in a number of machines this ratio only reaches a value of 0·3 or so. We believe that actually in the "Sidestrand" the extra wing weight which was the "price paid" for the higher value of Span²/W amounted to some 200 lb., but at that it paid to carry the extra weight.

While on the subject of wing design, a few words concerning the method used by Mr. North and his staff in the choice of wing section may be of interest. The method was outlined by Mr. North in his series of articles to which reference has already been made, and consists in starting off with a consideration of the operational conditions to be met, and then, taking as a basis a good streamline shape, curving its centre line to give the required aerodynamic characteristics, the original streamline section being chosen of such a thickness that it will accommodate spars of sufficient depth. Thus, in any Boulton & Paul machine one is not likely to find any stereotyped wing section, although some of those in use may, more or less accidentally, have a fairly close resemblance to certain "accepted" sections. Incidentally, the original streamline shape taken as the basis is generated by the generalised Schoukowsky theory.

The wing cellule having been carefully designed to meet the particular operational conditions of the type in question, great care is again taken in the design of fuselage and engine nacelles. In the case of the "Sidestrand," for instance, a start was made with a body of very good streamline shape, generated as in the case of the wing sections, a model of which was tested in the wind tunnel. The cockpits were then added one by one, the drag being measured after each such addition. If a certain cockpit shape or arrangement was found to add unduly to the drag, modifications were made until the figure had been reduced to what appeared to be the lowest practicable value. Take for example the prone gun position under the fuselage. Obviously this might easily increase the body drag to a very high figure, but by persistent experimentation the drag caused by this gun emplacement was ultimately reduced to a very low value indeed.

The engine nacelles were the subject of similar research and the form finally chosen, which is well shown in several of our photographs, has given about as low a drag as it is possible to attain with engines placed outboard. The research included wind tunnel tests with model airscrews running, and at large angles, it having been found that the "interference drag" is largely an induced drag and liable to be greater at large angles, thus affecting performance on climb, etc.

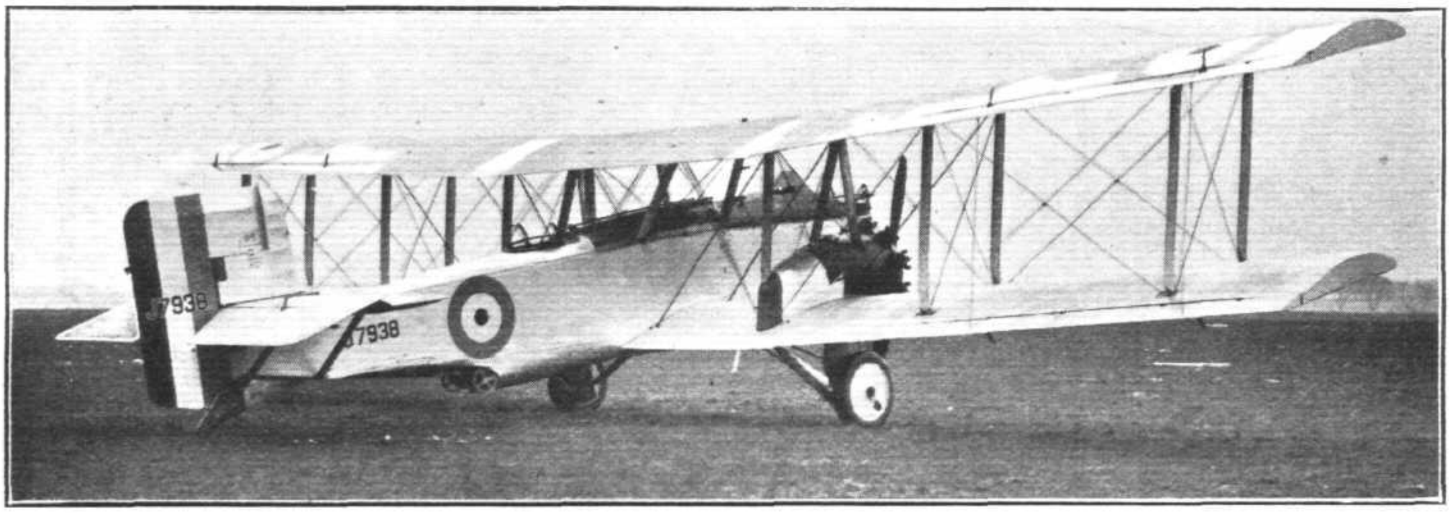
Undercarriage design, although perhaps more of a structural than an aerodynamic problem, also shows this striving for aerodynamic "cleanness," the undercarriage of the "Sidestrand" being of remarkably low frontal area for a machine of this size.

Altogether the Boulton and Paul "Sidestrand" is a machine which well repays a close study, the results of the very great care taken in its aerodynamic design being reflected in the performance figures which will be found at the end of this article.

Structural Design

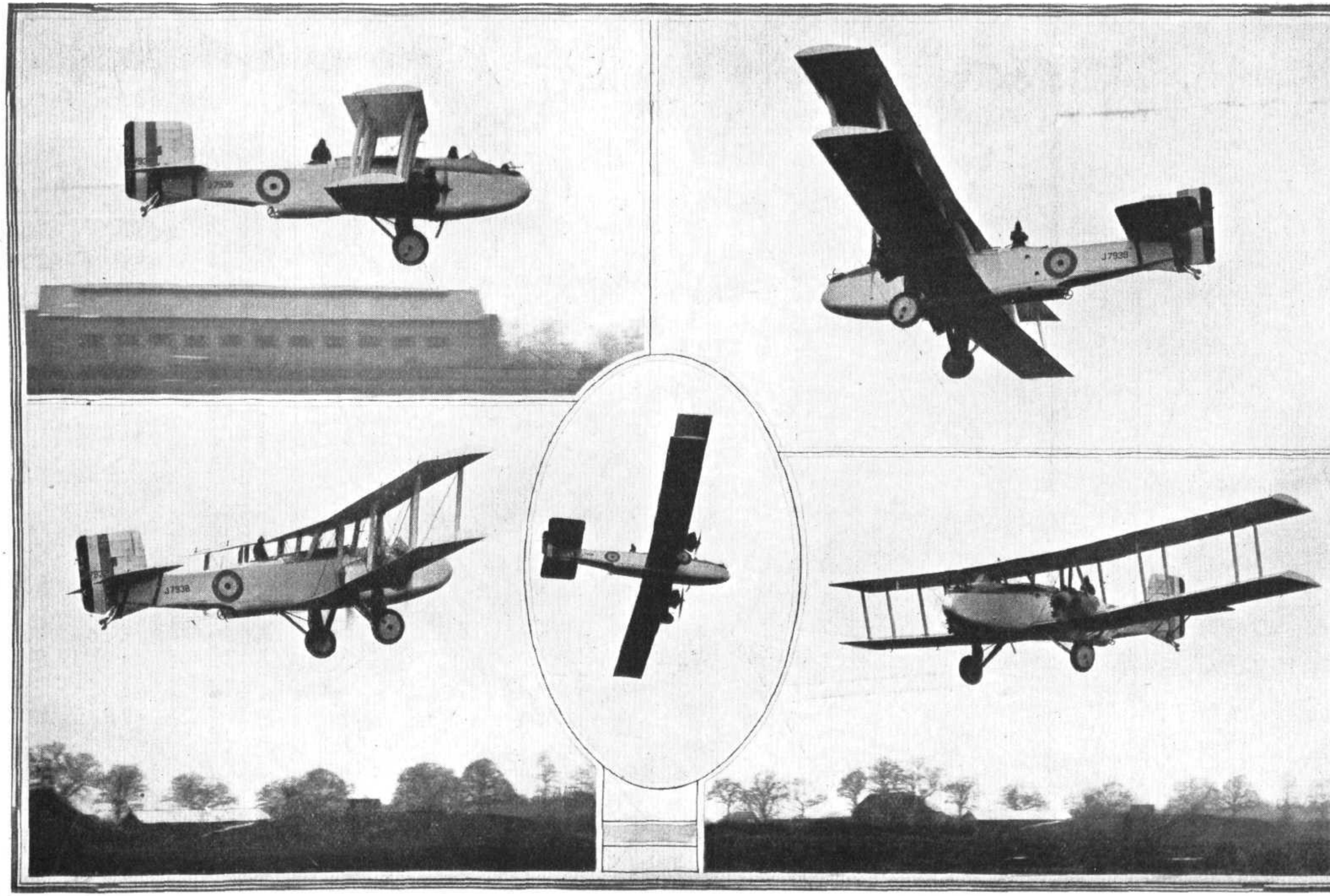
If the aerodynamic design of the "Sidestrand" is of more than usual interest, the same applies at least as much to the structural features. Although in what follows the reference is particularly to the "Sidestrand," most of the constructional details are now standard Boulton and Paul practice, and would apply fairly closely to any machine built by that firm, since a process of standardisation without cramping the freest possible development has been evolved by the firm during the last few years.

It will be known to most of our readers that Boulton and Paul were among the very first aircraft firms in England



["FLIGHT" *Photograph*

THE BOULTON & PAUL "SIDESTRAND": Three-quarter rear view. The careful streamlining of the engine nacelle can be seen in this photograph.



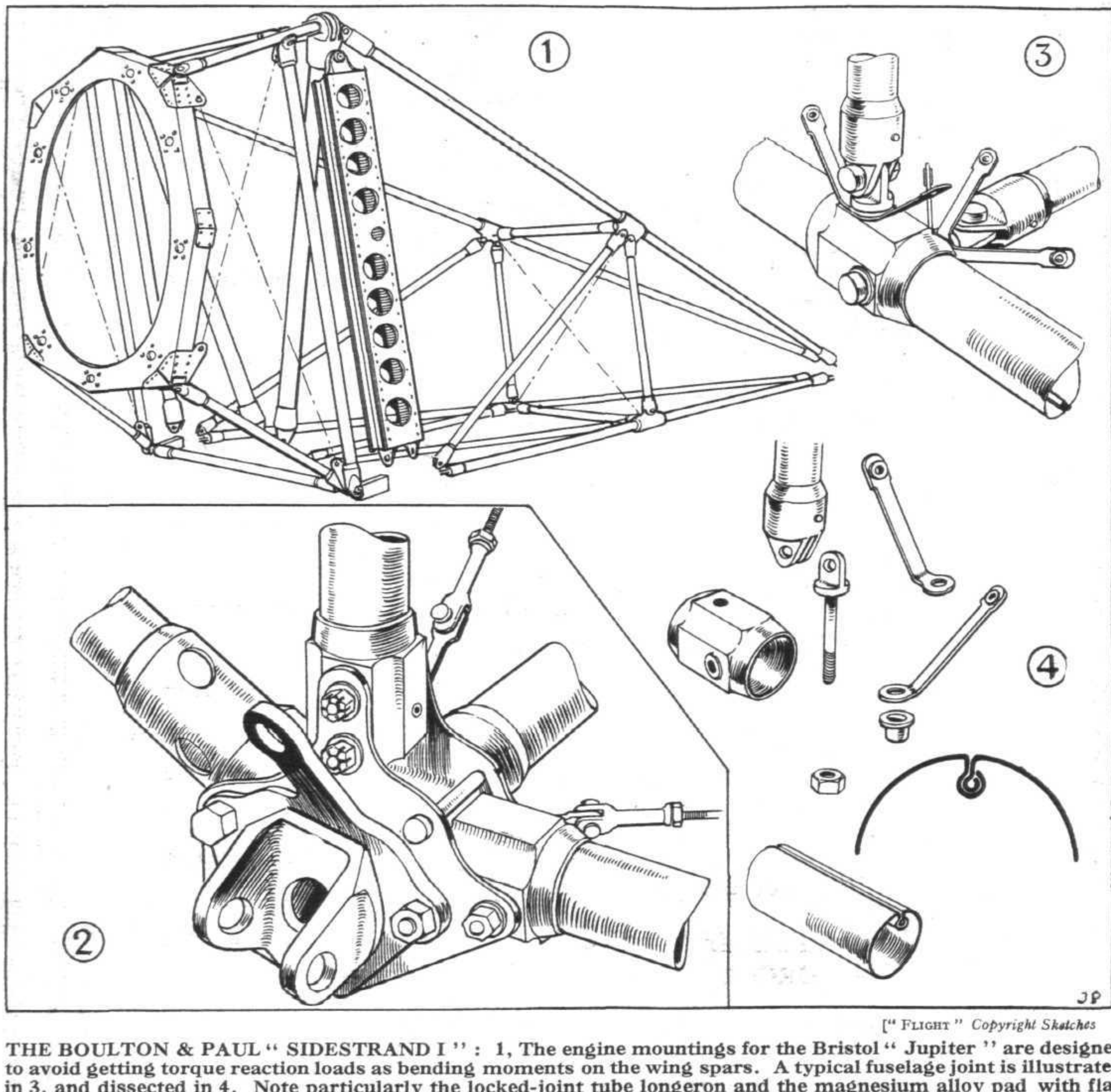
"FLIGHT" *Photograph*

SPAN ²/W : Five photographs of the Boulton & Paul " Sidestrand " in various attitudes, which show the large span and " clean " lines of the machine.

to take up all-metal, and more particularly all-steel, construction of aircraft, and a visit to the works at Norwich very soon reveals the fact that a very high degree of perfection has been attained, not only in the design of metal members but also, and which is, perhaps, even more important because it is a good deal more difficult, in rapid and relatively cheap manufacturing processes. Concerning the latter, but little can be said in the present article, in which we must confine ourselves to the finished results rather than go into details concerning the manner in which these results were obtained.

Earlier forms of Boulton and Paul metal fuselage construction have been described and illustrated in FLIGHT from time to time, but with the present form something like finality has been attained, since certain sizes have been standardised. The basis of the new form of fuselage construction is the locked-joint circular tube, which is a relatively recent product of the firm. This type of tube is made from strip, by a special process of rolling and drawing, and the accuracy obtained is really remarkable. Not only does the tube leave the draw bench "as straight as a die," but the locked-joint seam itself is perfectly uniform and straight, *i.e.*, there is no twist in the tube. This is important because of the attachment of fittings, for which it is desirable to know exactly where the seam is going to come, and that it will be in the same place at all fittings.

Having evolved an eminently satisfactory type of tube for longerons and struts, standardised in a certain number of sizes, the next step was to design a neat type of fitting for the attachment of struts to longerons. How the problem was ultimately solved is indicated in some of our sketches. A tubular "pad" of magnesium alloy, fitting snugly over the tubular longeron, and with flat faces machined on the outside, gave the solution. Bolts pass through "pad" and longeron vertically and horizontally (being, of course, slightly staggered in relation to each other), the strut ends being attached to the bolt heads and the bracing wires to sheet steel links or wiring plates in the manner shown. The bolts themselves are of Duralumin, and bushes are interposed between them and the walls of the longerons to increase the bearing area. The arrangement will be clear from our sketches. By the employment of magnesium alloy "pads" and Duralumin bolts, the weight of the fuselage fittings is kept down to a very low figure, while certainly the locked-joint tubes, of high-grade steel, are lighter than any drawn tube could be. The result is a structurally very economical construction. We regret that we have no figures relating to the bare structure weight of the "Sidestrand" but knowing the amount of equipment carried, and the difference between tare weight and gross weight, it is fairly obvious that the aircraft structure must be a very low percentage.



["FLIGHT" *Copyright Sketches*

THE BOULTON & PAUL "SIDESTRAND I": 1, The engine mountings for the Bristol "Jupiter" are designed to avoid getting torque reaction loads as bending moments on the wing spars. A typical fuselage joint is illustrated in 3, and dissected in 4. Note particularly the locked-joint tube longeron and the magnesium alloy pad with flat faces for the fittings. A slightly different fuselage joint is shown in 2.

If the fuselage structure is unusually interesting, the wing structure is no less so, although showing, perhaps, a less noticeable departure from Boulton & Paul's previous forms of wing structure. We believe we are correct in stating that this firm was among the pioneers of rolled steel strip wing spar construction, at least in its efficient modern form using high-tensile steels. And it is certainly the first British firm to standardize a scheme of construction by which all conceivable manner and sizes of wings may be built from standardised parts.

Of the Boulton & Paul method of manufacturing steel spars, nothing need be said here. Suffice it to point out that manufacturing processes have been evolved which allow of both rapid and cheap production. What is of interest is the system of standardising certain spar flanges, webs and fittings in a manner which gives a sufficient number of combinations to meet well-nigh every possible demand without having to go to the expense of making special rollers and dies. A few of the standardised combinations of webs and flanges are shown diagrammatically in one of our illustrations. It will be seen that, with three standard webs, and six standard flanges, 18 different spars are produced, giving quite a wide range. Add to this the fact that further variety may be added by a change of material, even to a change from steel to Duralumin, and it will be obvious that the range immediately available is very wide.

Incidentally, the accuracy of production is within 0·01 in., thus ensuring complete interchangeability, which is even more important from the point of view of mass production than repairs. It might here be mentioned that all Boulton & Paul strip is formed in the soft state, and hardened and tempered after forming.

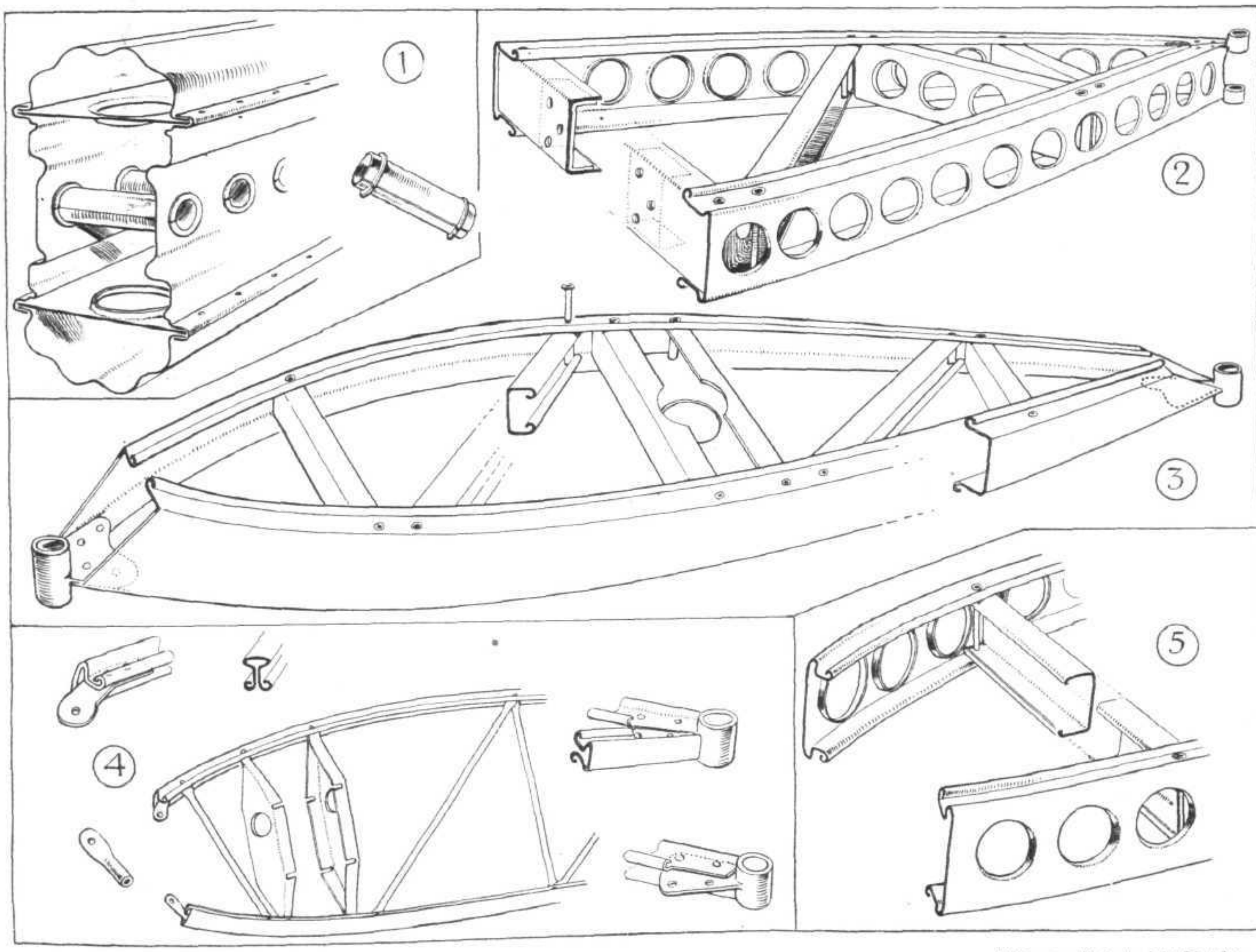
The rib design is very simple, and consists of channel flanges and tubular distance pieces forming the girder webs. This applies to the normal rib. At points where heavier stresses have to be withstood, modified forms are used, also of channel section, but with larger channels, and with channel section distance pieces. Several types are shown by sketches.

The attachment to the spars of internal drag struts and inter-plane struts is effected via bridge pieces in such a manner as to impose no crushing stresses on the thin-walled spars, the loads being taken either on the bridge pieces or on bolts passing through the distance-tubes in the spars.

Without being a very detailed description of the construction of the "Sidestrand," the above notes should give a general idea of the types of structure employed. In the absence of an explanation of the internal arrangement of the fuselage, which would necessitate a reference to equipment of a military nature, about which nothing may be said, we must confine ourselves to stating that the load of bombs forming the *raison d'etre* of the machine is carried inside the fuselage instead of outside. In this way a great deal of air resistance must be saved, and doubtless this fact has contributed materially towards the good performance attained.

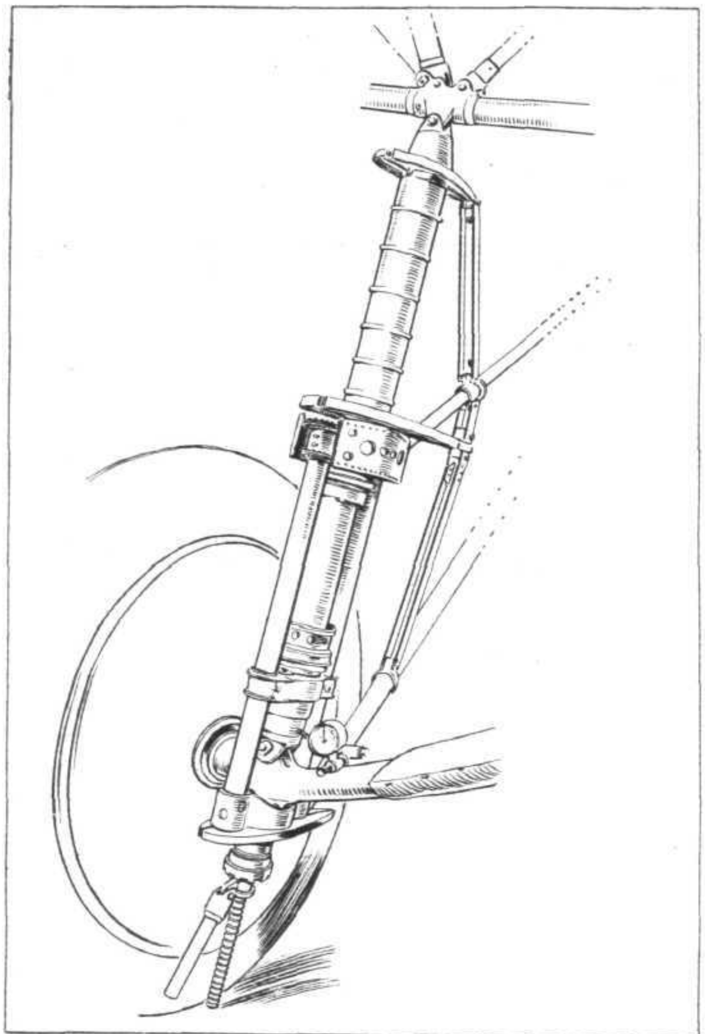
The Bristol "Jupiter VI" engines are mounted on the lower wing, the supporting structure being rather neatly triangulated in a manner to avoid torque reaction stresses being transmitted to the wing spars in the form of bending moments. The engines are hung on swivelling mounts which greatly facilitate inspection. The petrol tanks are situated in the fuselage, and number three in all, a front main, a rear main, and a service tank. The full tankage is 260 gallons, of which 35 gallons represent an overload to be used for long flights or some such special occasion, the normal capacity being 225 gallons, of which 65 gallons in the service tank, 90 gallons in the front main tank, and 70 gallons in the aft main tank.

The undercarriage of the "Sidestrand" is of simple two-wheeled type, with oleo-pneumatic telescopic "legs" of somewhat unusul design. A long stroke is one of the features



["FLIGHT" *Copyright Sketches*

THE BOULTON & PAUL "SIDESTRAND I": Some constructional details of the wings. 1 is a spar section, with inset showing the distance-tube bracing the web walls together. A standard wing rib is shown in 4. The attachment to the spars is by means of the notched plates shown, the notches fitting over the spar flanges along the lines of rivets. A somewhat stronger form of rib, used at points where concentrated loads occur, is illustrated in 2, while 3 shows a rudder rib. Further details are illustrated in 5.



One of the undercarriage " legs " of the Boulton & Paul " Sidestrand." The streamline fairing has been removed to show the arrangement.

of this " leg," and it is quite remarkable to see the " Sidestrand " taxying at high speed across rough ground, the machine itself remaining steady, while the " legs " are telescoping in and out, the wheels moving up and down with the uneven surface. In place of a sectional drawing of the actual " leg," which would have to be of a highly technical nature, we publish a diagrammatic representation which will serve to illustrate the general principle upon which the " leg " is designed.

The lower portion of the " leg " is filled with air (pumped in at an initial pressure of 125 lb./sq. in.), and the upper part with oil, a floating diaphragm separating the air from the oil. A piston is attached to, and moves up and down with, the lower part of the leg. This piston has in its head a valve seat and a spring-loaded hollow-stem valve. This hollow or cylindrical stem is provided with ports, so that when the valve opens, the oil can pass through from one side of the piston to the other. In the valve head is a small leak hole. This, of course, permits oil to pass through under all conditions.

When the " leg " is subjected to a load, the air is compressed by the upward movement of the lower half. If the movement is a relatively gentle one, oil merely leaks through the small leak hole in the valve head. When a certain speed of travel is reached, however, the valve opens against the action of its spring, and the oil is then permitted to flow through the ports in the valve stem, from the space above the piston to the space below it. The size of leak hole and ports has been carefully proportioned so as to give, in conjunction with the compressed air *and* the pneumatic tyre, a deflection diagram of the right shape. In taxying, the damping of the oil is such as to prevent any tendency to bouncing, and the machine travels along on an even keel, although on rough ground the wheels may be seen to be moving up and down rapidly, following the irregularities of the ground. The small air vent pipe shown may possibly pass a small amount of oil during the travel of the " leg," but its chief function is to avoid the formation of an air lock while the " leg " is being filled with oil. The jack shown in the diagrams and in a sketch can be used for extending the " leg," or for tyre changing, etc., as well as for relieving the " legs " of load when the machine is standing in a shed for long periods.

Specification

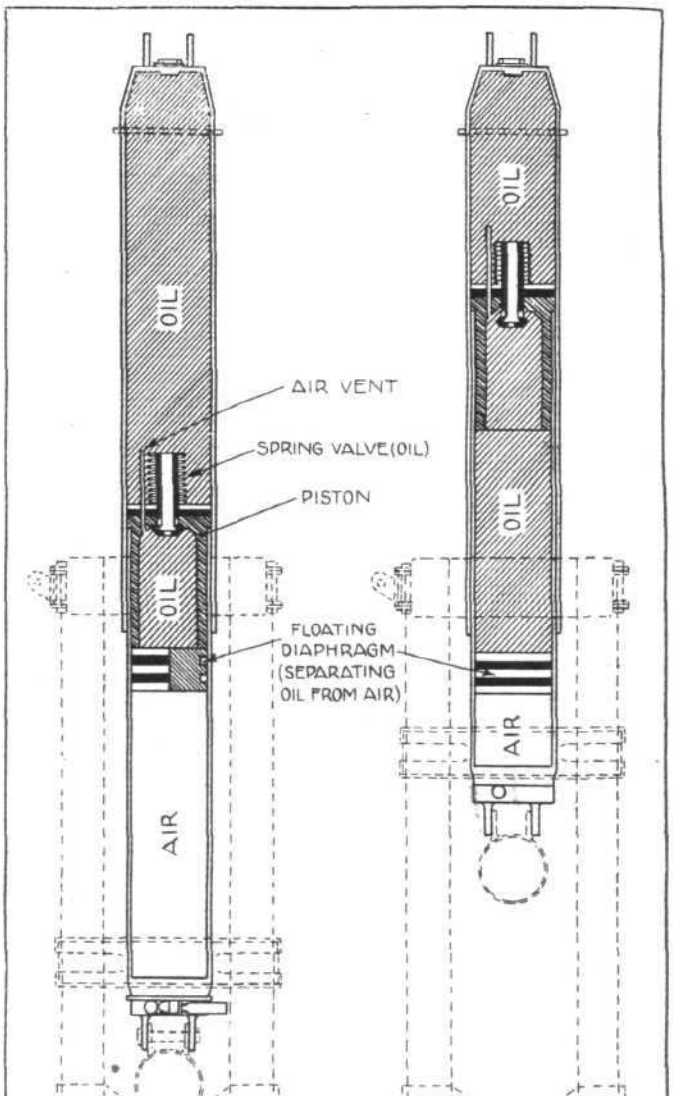
The main dimensions of the " Sidestrand I " are shown on the general arrangement drawings. The weight of the machine light, is 5,275 lb. (2,400 kg.), and the load carried is 3,575 lb. (1,625 kg.), giving a total loaded weight of 8,850 lb. (4,025 kg.).

The wing loading is $\frac{8,850}{944} = 9 \cdot 37$ lb./sq. ft. ($45 \cdot 9$ kg./m²).

Power loading (on normal power of 450 b.h.p. per engine) $\frac{8,850}{900} = 9 \cdot 84$ lbs./h.p. ($4 \cdot 47$ kgs./h.p.). " Wing Power " = $0 \cdot 95$ h.p./sq. ft. ($10 \cdot 25$ h.p./m²).

Performance

Speed at ground level, 125 m.p.h. (201 kms./hour).
Speed at 5,000 ft. (1,525 m.), 130 m.p.h. (209 kms./hour).



Diagrammatic representation of an undercarriage " leg " of the Boulton & Paul " Sidestrand I " The valve has a leak hole in its head, and ports in the tubular stem.

(*Concluded on p.* 213.)

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

March 29, 1928

CONTENTS

EDITORIAL VIEWS

In his previous article on "Metal Construction Development," Mr. Pollard dealt with the subject of fuselage members made from strip material. In the present issue he turns to the subject of wing spars made from strip, and gives illustrations of various types, such as the Boulton and Paul, Armstrong-Whitworth, and "Bristol."

We had rather expected that some of our readers would have offered certain mild criticism of one or two things in Mr. Pollard's article in the February number of THE AIRCRAFT ENGINEER, which appear to be a little open to doubt, or at any rate to discussion. As no one has done so, perhaps we may be permitted to call attention to these points, so that, if they are unimportant we may be informed to that effect, while if they are of importance it is essential that they should not be overlooked.

In Table I on p. 14 of the February 23 issue, Mr. Pollard gave, in column 9, the thickness of material for longerons and struts of a strip frame, some of the latter being only 0·006 in. thick. We have not, perhaps, the same access to materials specifications as have aircraft firms, but to us it seems that such strip might easily vary at least 0·001 in. either way. If it does, it would appear that the strength of the member made of such thin stuff might vary by, perhaps, 30 per cent., quite apart from any question of the effect of corrosion on material of this "fag paper thickness." It would, we think, be of interest if Mr. Pollard would inform us whether his experience has indicated that any risk of this nature is likely to be met with in practice.

The second point to which we should like to refer is the load of 800 lb. assumed to be applied at 0 in Fig. 1, on p. 14. On p. 17 Mr. Pollard states that the dimensions and loads are such as might apply to the structure of a machine weighing 4,500 lb. gross weight. In view of the fact that in most machines of normal proportions the tail skid load is somewhere in the neighbourhood of 10 per cent. of the weight, is not 800 lb. too small a load to assume? In other words is not the factor of safety too small?

METAL CONSTRUCTION DEVELOPMENT

By H. J. POLLARD, Wh.Ex., A.F., R.Ae.S.

(*Continued from Page* 17.)

Further questions of detail design may now be considered. We will consequently turn our attention to wing spars. The reader will probably be aware that the design of parts of aeroplane structures built up from metal strip began to be very seriously considered late in the year 1918, when the rapidly dwindling supplies of long lengths of timber suitable for spars made it urgently necessary that these members should, if possible, be made from other materials. With the end of the war the intensive study of the possibilities ceased, but sufficient work had been done to prove that metal spars suitable for normal single-seater and two-seater machines could be made which would show substantial savings in weight over wooden spars of the same strength. Very efficient shallow spars, 2 to 4 ins. deep, were than made and tested, but the early promise of rapid development did not materialise. Sufficient data for the successful design of deeper spars was not available and the problem of making metal ribs of equal weight and stiffness compared with timber ribs was found most difficult to solve. Speaking generally, it is not difficult for a spar designer to produce a section from 2 to 5 ins. deep, giving a stress of 60 to 70 tons per sq. in., but between, say, 5 and 12 ins. this result is not easy of attainment. Above 12 ins. the ordinary box spar, and probably the single web spar, is scarcely practicable, and a girder arrangement is likely to prove more efficient. In particular cases, by the introduction of numerous and varied stabilising members, exceptions could be made to the above general statements, but special cases of spar design need not at the moment concern us.

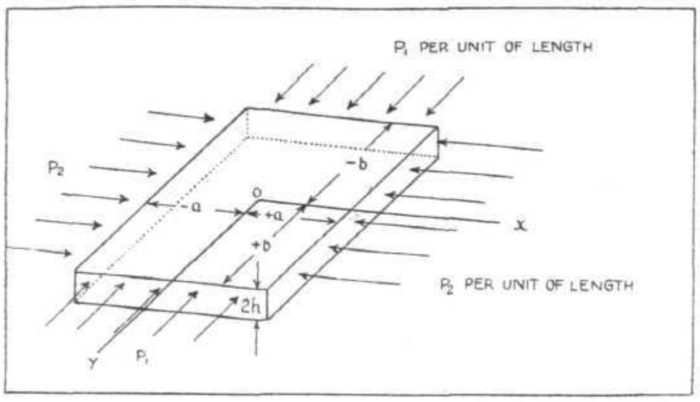
In the design office well supplied with drawings of sections of spars and with information regarding the stresses that are developed by various kinds of loading, the task of selecting an old or designing a new spar is simple, providing no radical departures are made from previous practice.

The purpose of this article is to bring to the notice of the technician who is inexperienced in these matters, considerations which should help him to succeed in designing spars or other structural members in thin metal. An investigation of a simple concrete example brings out some of the chief points, but we will in the first instance review two important cases of the effects of stress which have been investigated mathematically.

In his treatise on Mathematical Theory of Elasticity Prof. A. E. H. Love studies the case of a rectangular plate

having sides of length $2a$ and $2b$, and thickness $2h$, secured at the edges and acted on by edge thrust P_1 per unit length in the direction of side of length $2a$, and P_2 per unit length on the side of length $2b$.

The conditions of loading and the dimensions of the plate are shown in the following diagram.



The form of the solution is

$$w = W \sin \frac{m\pi(x+a)}{2a} \sin \frac{n\pi(y+b)}{2b} \quad \ldots\ldots\ldots\ldots (1)$$

provided that

$$\tfrac{1}{4} D\pi^2 \left(\frac{m^2}{a^2} + \frac{n^2}{b^2}\right)^2 = P_1 \frac{m^2}{a^2} + P_2 \frac{n^2}{b^2} \quad \ldots\ldots\ldots\ldots (2)$$

where w is the displacement of a point on the plate at (xy) from the origin

W is a constant.

m and n integers (giving the number of corrugations or "waves" parallel to the sides of the plate)

and $D = \frac{2}{3} \frac{E h^3}{1-\sigma^2}$ this term is called by Prof. Love the "flexural rigidity" of the plate.

σ is Poisson's ratio for the material of the plate. The above equation gives the critical thrusts. For example, if $P_1 = P_2$ the critical value of P_1 and P_2 is $\frac{1}{4} D\pi^2 \left(\frac{1}{a^2} + \frac{1}{b^2}\right)$

If we take the case of a box spar with a flat plate flange then $P_2 = 0$ and $n = 1$. It is assumed that P_1 is the only force acting on the plate.

Then $$\frac{Eh^3\pi^2}{6(1-\sigma^2)} \left[\frac{1}{(a/m)^2} + \frac{1}{b^2}\right]^2 = P_1 \frac{1}{(a/m)^2} \quad \ldots\ldots\ldots\ldots (3)$$

Therefore for minimum P_1 (at critical equilibrium)

$a/m = b$ (obtained by differentiating P_1 with respect to a/m and equating to zero).

Consequently, $\frac{Eh^3\pi^2}{6(1-\sigma^2)} \frac{4}{b^4} = \frac{P_1}{b^2}$.

or $P_1 = \frac{2}{3} \frac{Eh^3\pi^2}{(1-\sigma^2)b^2}$

If the stress intensity is p, then $P_1 = p.z.h$.

$$p = \frac{E\pi^2}{3(1-\sigma^2)} \left(\frac{h}{b}\right)^2 \quad \ldots\ldots\ldots\ldots (4)$$

The second case is that of a thin tube under compressive end load. Three types of failure may occur, according to the dimensions of the strut:

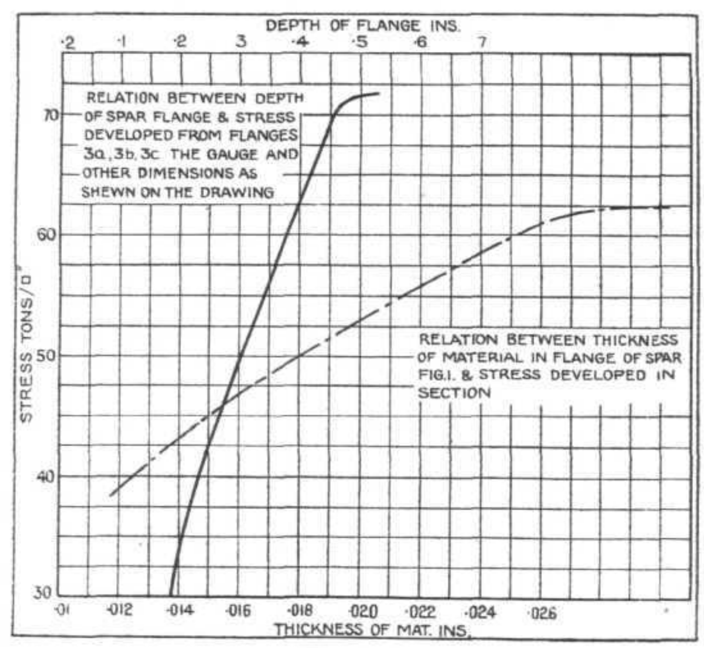
(1) The well-known failure caused by the induced stress exceeding the compressive yield of the material.

(2) Failure brought about by elastic instability of the strut as a whole, causing bending of the structure line of the member.

(3) Instability of the strut wall.

(1) and (2) are fully investigated in numerous text-books on structures or strength of materials, and no further attention need by given to them here.

It is only within comparatively recent years that the third case has received serious attention. In ordinary structural engineering the matter is of small importance, but in aircraft engineering the reverse is the case.



Graph 1.

Mr. R. V. Southwell obtained the formula

$$p = \frac{E}{\sqrt{3}} \frac{t}{R} \sqrt{\frac{m^2}{m^2-1}} \quad \ldots\ldots\ldots\ldots (5)$$

where p is the stress intensity at which a tubular strut would collapse through elastic instability of the walls.

E = Young's modulus,

t = wall thickness,

R = radius of tube,

and $\frac{1}{m}$ = Poisson's ratio.

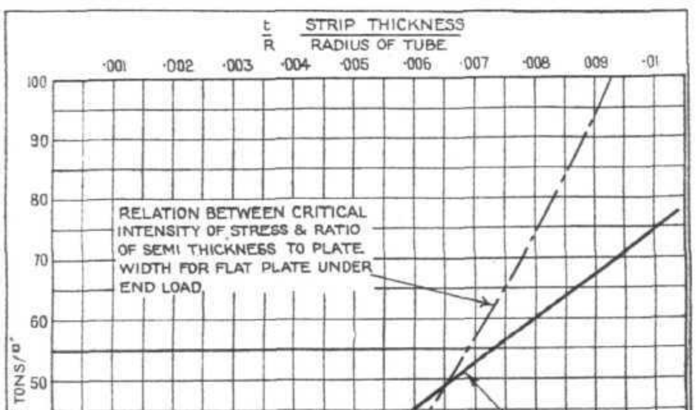
From this equation a value of $\frac{R}{t} = 115$ is obtained if $p = 65$ tons/sq. in.

Equations (4) and (5) are shown plotted in Graph (1).

E for steel has been taken as 12,500 tons per sq. in.

$\frac{1}{m^2} = \sigma^2$ „ „ „ 0·08 „ „

It has consistently been found that the ratios of t/R and



Graph 2.

$\frac{h}{B}$ are too low, the theoretical value of t/R for tubes showing a much greater discrepancy with experiment than does the value of h/B for flat plates.

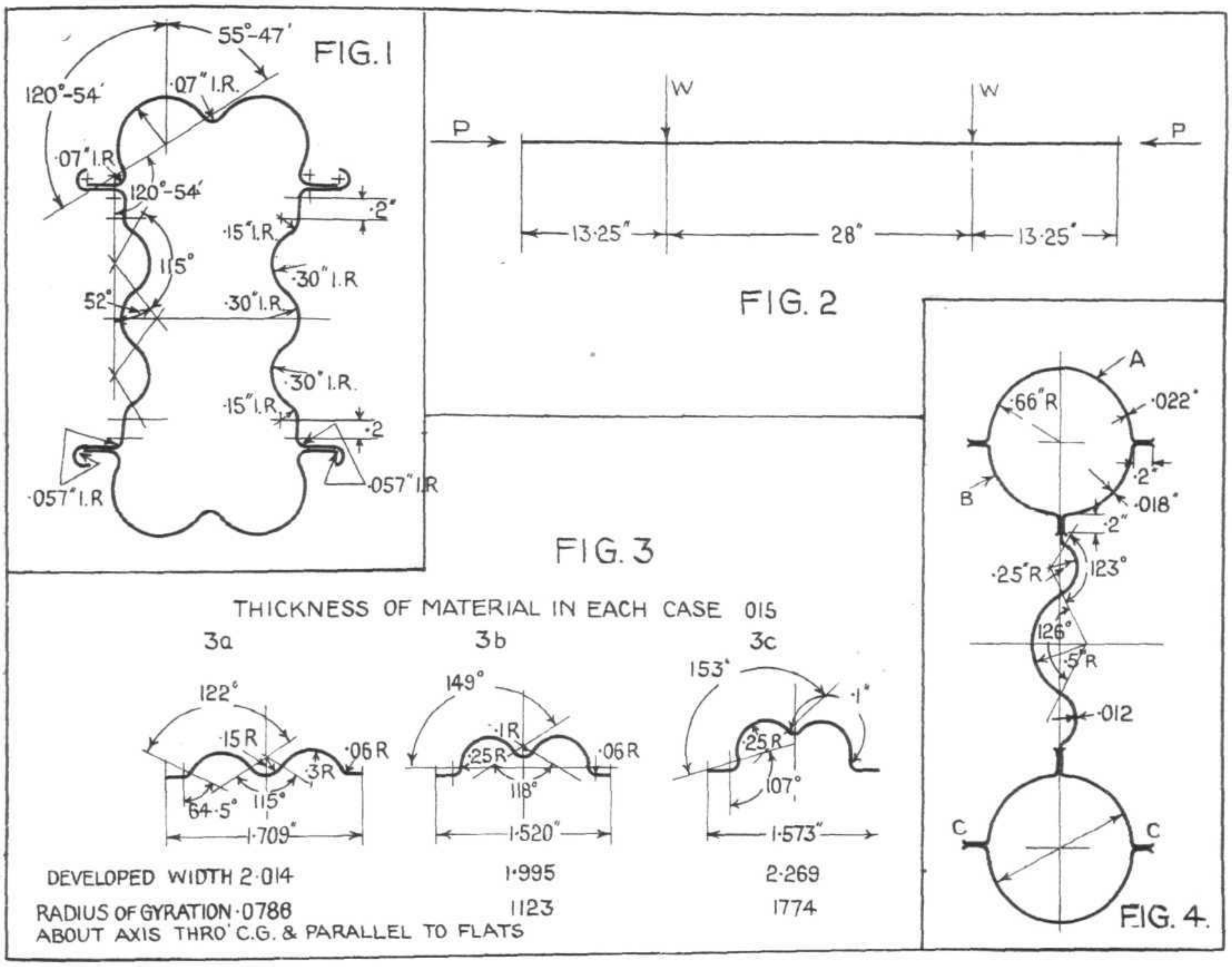
For the most carefully prepared and conducted tests on the most carefully made tubes the writer would expect to find increases of at least 50 per cent. in the value of t/R over the theoretical values for the same stresses.

Unfortunately, similar mathematically established formulæ have not been established for complete corrugated sections, but with the following notes and the above equations as a guide the trained technician should not experience great difficulty in inventing his own formulæ for finding at what stresses the sections he designs will become elastically unstable, providing he has the opportunity of observing the behaviour of actual spars under load and has also the data to enable him to compare the results of a fair number of tests. Without the opportunity of actual observation any formulæ he may deduce would probably have little value.

In this summary of the factors that must have their place in the desired formulæ, obviously one of the most important will be K, the radius of gyration of the section. Component curves (arcs of circles are usually taken) of the cross-section must have a radius to thickness ratio proportional to the stress that is to be developed. The desired general large radius of gyration must not be obtained by the use of extended flats. The amount that can be allowed depends on the boundary conditions, but the ratio of flat width to thickness may rarely be permitted to exceed 20. Equation (4) above shows that the breadth of the section must be included, and also the thickness, as shown in equations (4) and (5). A term or terms involving the size and number of corrugations and their relative position must also be included, and a very important factor relates to the degree of fixation one portion of a section receives from an adjoining section, the numerical value of which is dependent almost entirely on experience. It is obvious, then, why it is inadvisable to attempt to publish formulæ at the present time for general use on built-up structure members. Such formulæ as have been deduced may be established mathematically at some time in the future; then that will be the occasion for publication. Failing mathematical support, it is probable that formulæ for particular types of spar only will be available, the limitations of each type being strictly defined.

Empirical formulæ containing terms whose values in particular cases are dependent purely on the designer's experience are scarcely suitable for publication, since the probability of misapplication by the inexperienced is too great.

It should, finally, be noted that, whatever expression is derived for determining the stress at which instability sets in, it must be capable of application to a complete section or to any portion of a section, however small, because the instability may concern a section as a whole, as, for instance, a complete spar flange or a portion of such a flange; in the latter case, for example, a portion of a flange might consist of an arc having an excessive R/t ratio at an early load, a dent or short-pitched wave might form along this part, which would subsequently develop and spread, causing the premature collapse of an otherwise perfectly stable section.



Elasticians will doubtless solve these problems in time in spite of their complexity, but, as in the case of the flat plate and tube formulæ, it is quite certain that the results of the mathematical investigations will need considerable modification on being brought into line with practice; hence is emphasised the need for large numbers of carefully conducted, recorded, and co-ordinated experiments.

Consideration of a selected few of the large number which

have been carried out for the Bristol Aeroplane Co. will furnish further useful information.

Fig. 1 is a section of a spar used extensively in "Bristol" designs. A series of tests have been made with this spar in various gauges; the dimensions of the test spar centres are shown in Fig. 2, and the ratio of end load to lateral load was

$$P = 24\ W.$$

P being the thrust and W half the lateral load.

In Graph 2 the relation between the stress developed and the gauge of the flange is shown.

The results of three other experiments relating to flanges numbered $3a$, $3b$ and $3c$ are shown, but in this case stresses developed are plotted against depth of section (see Graph 2). As an exercise the student of the problem should try to form an expression from the data given which, when evaluated, gives approximately the stress developed on the tests. Flange $3a$ was not designed for use in a spar, but for a compression rib; it was convenient, however, on one occasion

Take the bending moment across this section to be 31 inch/tons. Then, assuming the web section to be adequately supported (by ribs or other means—a matter that will be briefly mentioned later), the section A should withstand the maximum stress of approximately 65 tons/sq. in. that would be induced. Portion B has to withstand an average stress of about 40 tons per square inch, and consequently the thickness would be much less, as shown, while the stress across the web varies from a small negative to a small positive amount, and consequently the web thickness could have a value as shown: as dimensioned this web would probably withstand a compressive stress of about 22 tons per square inch or a thrust of 1,600 lbs.

The student should work out many such examples for himself, taking different cases of bending moments, deflections, and end loads. The manufacturing side of the question should be kept in view; for instance, it would be foolish at this stage to call for strip tapering in thickness from, say,

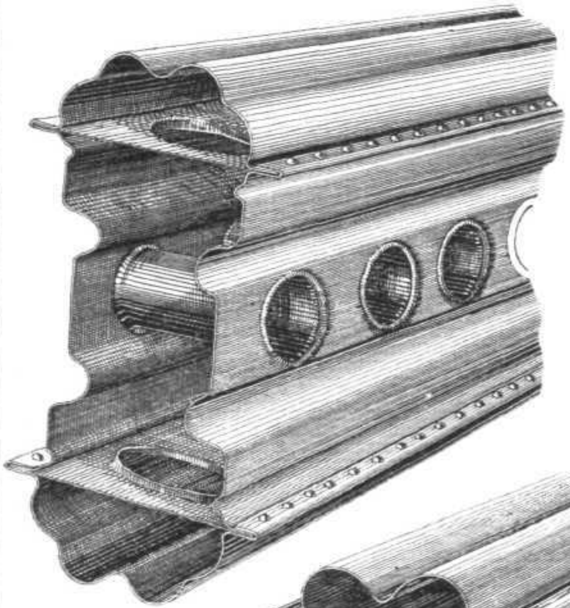


FIG. 5.

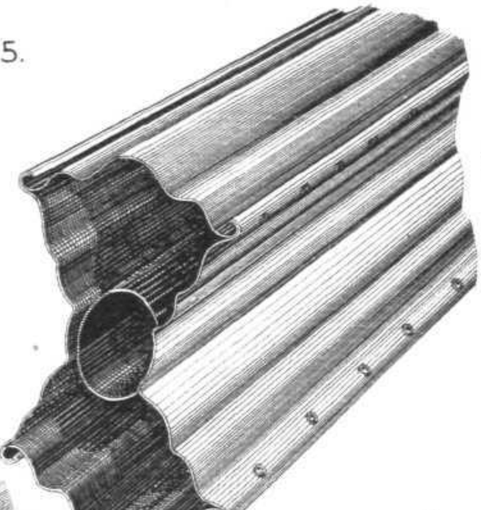


FIG. 6

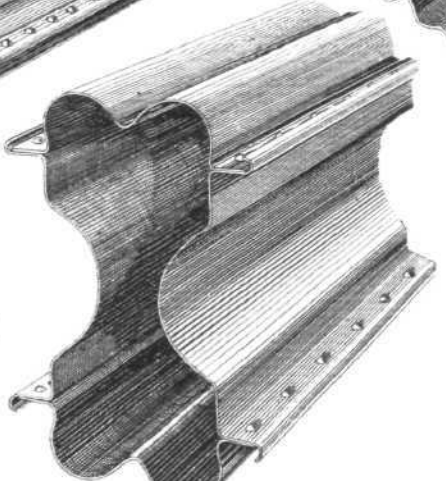


FIG. 7.

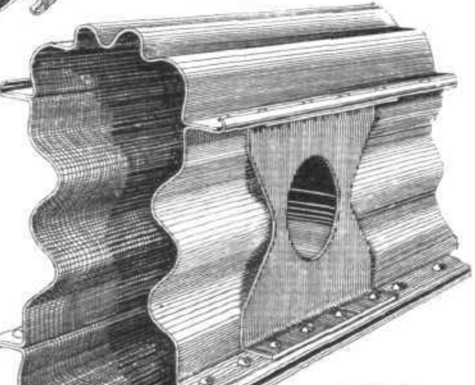


FIG. 8.

to use the section in a spar. This particular spar was the bottom rear member in the metal wings of the Bristol Lucifer preliminary training machine.

The stress in an ideally designed spar would be constant along the length and across the breadth of the section at all points, and for the material used would be the maximum permissible for the maximum loading. This state, of course, is impossible of attainment, usually load factors at points of support and points of maximum bending between supports reach the lowest permissible figure. In spars made of timber, but particularly in those made from oval tube, there is little scope for making variations in thickness of material, particularly across sections where the stress variation is generally very wide.

From Fig. 4 the ease with which variations can be made with strip spars is apparent.

$$\left.\begin{array}{l} \text{I of the section} = 1{\cdot}2 \\ \text{Z} \quad ,, \quad ,, \quad = 0{\cdot}48 \\ \text{A} \quad ,, \quad ,, \quad = 0{\cdot}34 \end{array}\right\}\text{approx.}$$

$0{\cdot}018$ to $0{\cdot}01$ in., but longitudinal variations in metal disposition are very easily made—for example, as in the case of Fig. 4. If part A were subjected to an extra compressive stress along a portion of its length, an extra lamination or laminations could readily be slipped over and secured at C and C, nor would it be necessary to secure the flanges together on their curved surfaces, securing of the flats being sufficient.

It is often convenient in the case of cantilever spars to have a number of laminations at the root, falling off to a single thickness at the tip, thus securing a fairly even distribution of stress. (For practical purposes it is not necessary to have the shape of the outside of one lamination exactly the same as that of the inside of another, that is to say, a single set of tools will often serve for all the laminations.)

Because of the ease with which high stresses can be developed in shallow members it often happens that a good spar reckoned on a strength/weight basis can be designed which only occupies a portion of the depth of the aerofoil,

say, 55 or 60 per cent., and which also may have the advantage of enabling external bracing fittings to be totally enclosed in the aerofoil. While this latter is very desirable it is better to obtain this by other methods than cutting down the spar depth, as the shallower the spar the greater the deflection. The sight of a plane flexing up and down when a machine is taxying does not inspire the pilot with confidence, even though the wing might be quite steady in the air. Full advantage should be taken of the aerofoil depth, and for this reason Fig. 4 was chosen as an example of a type specially suited for deep aerofoils. This type of spar requires various web stiffeners, and it is the writer's opinion that development of high stresses in it is a matter of more difficulty than in the box spar type, but with the present trend of aeroplane design in the direction of fewer external struts, it is a type which will in the end pay for the labour that is put into its investigation and development.

A comparison of a few current types of spar will give some information on matters of design.

In Figs. 5, 6 and 7 are shown types of spars developed by Messrs. Boulton and Paul, Armstrong Whitworth, and the Bristol Aeroplane Company. The first and second are copied from the "Encyclopædia Britannica." Two very special features of the Boulton and Paul spar are (1) the very neat arrangement at the riveting edges, where the 180° web bend makes the assembly of these spars previous to riveting a very simple matter, and (2) the very excellent web support. The Armstrong spar is particularly noteworthy because of the entire absence of flats, the flanges and webs being wholly curved. A special feature of the "Bristol" spars is the rather wide flat riveting edges, which enables the external fittings to be secured *after* the long box has been riveted up along its four edges, as shown in Fig. 8. These fittings take the form of shallow channels secured to the spar edges after assembly, making possible a continuous process of assembly, in which holes may be punched and rivets clinched simultaneously under a gang press. Rivets are at the moment put in by hand between each stroke of the press, but the possibility of an entirely automatic assembly process in which the rivets may be fed into place mechanically are evident.

These wide flats might easily be a source of weakness in the spar, but they are kept as far from the points of maximum stress as possible and a very substantial curl terminates the web edges.

On tests on short spars where the end load has greatly exceeded the lateral load there has been a tendency for these flats to fail before the yield point of the material has been reached; but the simple manufacturing processes permitted by the design has made it worth while using a heavier gauge flange or web in the one or two isolated cases that have occurred.

The question of "developed stresses" in spars is obviously of an extremely complicated nature. Formulæ deduced from the Euler Bernoulli theory are used for the simple reason that there are no others to replace them; they are, moreover, easy of application. Anyone who has seen the formation of long-pitched waves in the compression flange of a spar or seen dents developing round rivets or observed the spar visually contracting in depth or spreading in breadth must have felt that the process of multiplying the end load and deflection, dividing by the section modulus, etc., was yielding a result having little bearing on the actual stress intensity in the spar under load. It might be argued that the above process results in very approximate figures of comparison, but even in this case consideration would have to be given to the methods of loading.

The student should be on his guard against being misled by what are popularly and erroneously called "figures of merit."

AN OMISSION

The attention of readers is drawn to an omission, due to an oversight, of a radius dimension on Fig. 1 of Mr. Pollard's illustrations. The Figure will be found in the top left-hand corner of the set on p. 23, and the missing radius dimension refers to the radius arrow shown in the left-hand lobe of the top spar flange. Readers desiring this figure to be complete are asked to insert at that point the dimension 0·05" O.R.

SEAPLANE STABILITY CALCULATIONS.

By WILLIAM MUNRO.

(*Concluded from page 20.*)

5. *Displacement to Load Water Line.*

This is tabulated in similar fashion to the calculation of total displacement, but in this case the areas of half-sections entered in column 2 are taken below water-lines, as indicated on body-plan Fig. 5. Thus we get:—

Station.	Area of Half-section.	Simpsons' Multiplier.	Functions of Areas.
12	0·0	½	0·0
11½	0·0	2	0·0
11	0·04	1½	0·06
10	0·60	4	2·40
9	1·11	2	2·22
8	1·38	4	5·52
7	1·54	2	3·08
6	1·70	4	6·80
5	1·31	2	2·62
4	1·14	4	4·56
3	0·91	2	1·82
2	0·69	4	2·76
1	0·46	1½	0·69
½	0·29	2	0·58
0	0·0	½	0·0
			33·11

Displacement to L.W.L. $= \frac{33 \cdot 11}{1} \times \frac{1 \cdot 725}{3} \times \frac{2}{1} \times \frac{64}{1} =$ 2,427 lbs.

The displacement to load-water line is the total function of areas multiplied by one-third the interval between stations and multiplied by two for both sides of the float: then brought to pounds by multiplying by 64.

6. *Position of Centre of Buoyancy.*

This has to be found—

(*a*) vertically;

(*b*) fore and aft.

(*a*) Is not usually worked out in detail, but is taken approximately as a known ratio between the distance of the C.B. below the load water line and the maximum draught of the float to the same waterline.

This ratio is given by Major R. E. Penny, A.F.R.Ae.S., as 0·2 of the draught.*

If calculated, the method employed would be to make out a "Curve of Displacement" at varying water-lines, and then apply the same rule as used in ship-design, *i.e.*,

$$\frac{\text{Area of Curve of displacement}}{\text{Load displacement}} = \text{Distance of C.B. below L.W.L.}$$

* See paper on "Seaplane Development" by Major R. E. Penny, A.F.R.Ae.S., read before Royal Aeronautical Society, April 28th, 1927.

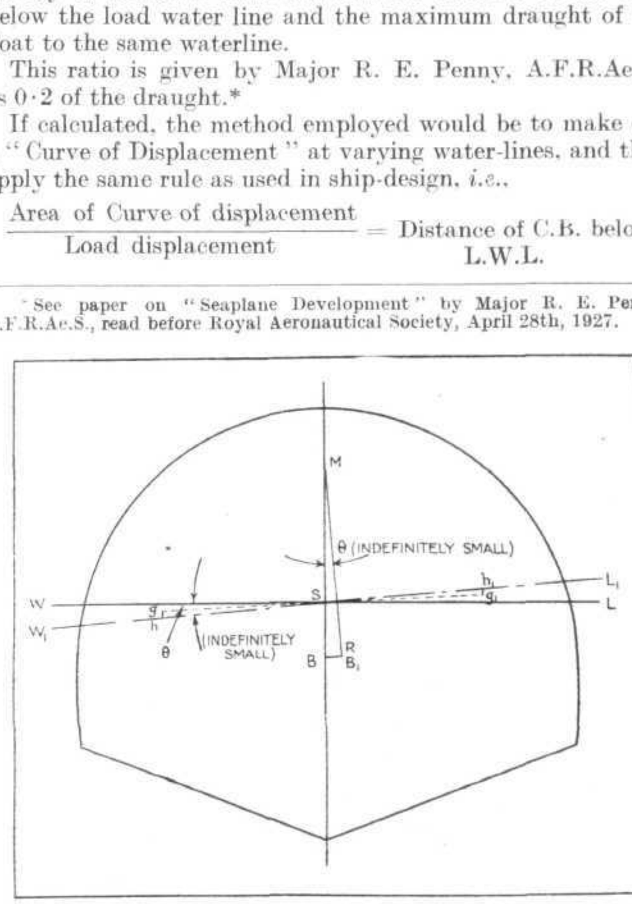


Fig. 7.

Each displacement at the different water-lines would be calculated as for displacement to load water line.

(*b*) Fore and aft position of centre of buoyancy.

To obtain this position we tabulate as under :—

Station.	Half-area of Section	Simpsons' Multiplier	Functions of Areas	Lever	Moments
12	0·0	½	0·0	6	0·0
11½	0·0	2	0·0	5½	0·0
11	0·04	1½	0·06	5	0·30
10	0·60	4	2·40	4	9·60
9	1·11	2	2·22	3	6·66
8	1·38	4	5·52	2	11·04
7	1·54	2	3·08	1	3·08
6	1·70	4	6·80	0	30·68
5	1·31	2	2·62	1	2·62
4	1·14	4	4·56	2	9·12
3	0·91	2	1·82	3	5·46
2	0·69	4	2·76	4	11·04
1	0·46	1½	0·69	5	3·45
½	0·29	2	0·58	5½	3·19
0	0·0	½	0·0	6	34·88
			33·11		

Excess aft $= 34·88 - 30·68 = 4·2$.

Centre of buoyancy aft of station $6 - \frac{4·2 \times 1·72}{33·1} = 2·5$ ins. (0·208 ft.).

The midship station, No. 6, of the float is taken as the starting point; the moments forward of No. 6 station are added together: similarly, the moments aft of No. 6 station are added together and the excess of moments aft is multiplied by the interval between stations and divided by the total of functions of areas.

We now have all the information necessary to determine what transverse metacentric height our flotation system will provide.

The formula used is B.M. $= \frac{I_0}{V}$

where B.M. is distance from Metacentre M. to centre of buoyancy B, and I_0 is moment of inertia about centre line of machine for two floats, and V is total displacement of two floats (in cubic feet).

This is shown by referring to Fig. 7, a single float being used as an illustration.

Let θ the angle of inclination be very small.

Y = W.S. or S.L.

v_1 = area of wedge W.S.W$_1$., or L.S.L$_1$.

v = volume of W.S.W. for whole length of float.

V = volume of displacement.

Then $v_1 = \frac{\text{S.L.} \times \text{L.L}_1}{2}$; but $\text{LL}_1 = \text{S.L. Sin } \theta$ (practically)

$\therefore \quad v_1 = \frac{\text{S.L.}^2 \sin \theta}{2}$

But $Sh_1 = 2/3$ S.L. by properties of triangle.

$\therefore h\,h_1 = 4/3$ S.L. when θ is very small.

Now $v_1 \times h\,h_1 = 4/3 \text{ S.L.} \times \frac{1}{2} \text{ S.L.}^2 \sin \theta = 2/3 \sin \theta \times \text{S.L.}^3$

$$\therefore v \times h\,h_1 = 2/3 \int Y^3 \sin \theta \, dx.$$

But $v \times h\,h_1 = V \times$ B.R., and B.R. = B.M. sin θ ;

$$\therefore V \times \text{B.M.} \sin \theta = 2/3 \int Y^3 \sin \theta \, dx;$$

$$\therefore \text{B.M.} = 2/3 \int \frac{Y^3\,dx}{V}$$

From Fig. 8 take a strip P.Q. of length Y and breadth (indefinitely small) dx. Then, regarding P.Q. as a rectangle its moment of inertia about the base DC is :—

$1/3\,(Y \cdot dx)\,Y^2 = 1/3\,Y^3\,dx$.

$(Ydx = \text{Area})$

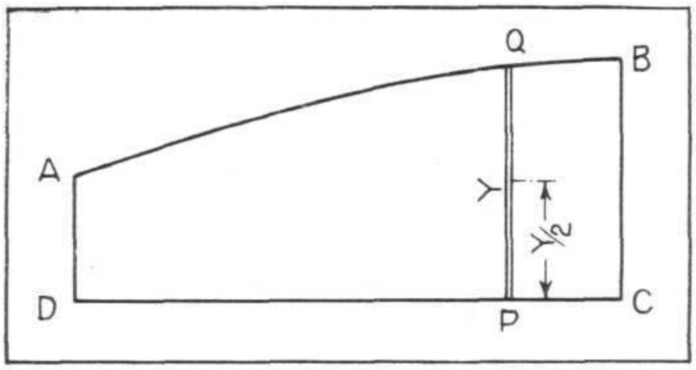


Fig. 8.

and the moment of inertia of the whole figure about DC will be the sum of all such expressions, giving us :—

$$\int 1/3\,Y^3\,dx.$$

Both sides of the float being symmetrical we get :—

Moment of inertia $I = 2/3 \int Y^3\,dx$.

(Y = Semi-Ord. of L.W. Plane.)

And as B.M. is shown above to equal $2/3 \int \frac{Y^3 dx}{V}$.

$$\therefore \text{B.M.} = \frac{I}{V}.$$

And as the floats are situated at a distance from the centre line of machine equal to half the track ; then I_0, the total moment of inertia is equal to I + (Area of W.P. × ½ track²) as previously calculated.

And

$$\text{B.M.} = \frac{I_0}{V} = \frac{856·8 \times 2}{75·84} = 22·5 \text{ ft.}$$

$$V = \frac{2427 \times 2}{64} = 75·84$$

The required Transverse Metacentric Height is therefore B.M.—B.G.

The position of G is known and B.G. we will assume is = 8′—0″.

∴ Transverse Metacentric Height or G.M.,

= 22·5 ft. − 8·0 ft.

= 14·5 ft.

Should the result arrived at not lie in the locus of results graphed for similar types of seaplanes, the easiest remedy is to widen the float track commensurately.

An example will make this clearer.

Taking the figures used throughout we will assume that the amount of metacentric height is not sufficient and that G.M. should be 15′ 0″.

The new B.M. therefore will be 8′ 0″ + 15′ 0″ = 23′ 0″.

And as B.M. $= \frac{I_0}{V}$

$\therefore \text{B.M.} \times V = I_0$

$\therefore 23 \times 75·84 = I_0$ for both floats

$\therefore \frac{23 \times 75·84}{2} = I_0$ for one float

$872·16 = I_0$ for one float.

And as $I_0 = I + (\text{Area of W.P.} \times \frac{1}{2} \text{track}^2)$

$\therefore$ Area of W.P. × ½ track² $= I_0 - I$

$\therefore 41·25 \times \frac{1}{2} \text{track}^2 = 872·16 - 21·54$

$\therefore \frac{1}{2} \text{track}^2 = \frac{872·16 - 21·54}{41·25} = 20·62$ ft.

$\frac{1}{2}$ track $= \sqrt{20·62} = 4·54$ ft.

∴ Track required = 2 × 4·54 ft.

= 9·08 ft.

Turning now to the Longitudinal Metacentric Height, we first find the Moment of Inertia of the Waterplane about the midship station, No. 6 as follows :—

Station.	Semi-Ord. of L.W.P. in feet.	Simpsons Multiplier.	F. of Areas.	Multiplier for Moments.	Products of Moments.	M. of I. Multiplier.	M. of I. Products.
1	2	3	4	5	6	7	8
12	0	½	0·0	6	0·0	6	0·0
11½	0·5	2	1·0	5½	5·5	5½	30·25
11	1·0	1½	1·5	5	7·5	5	37·5
10	1·34	4	5·36	4	21·44	4	85·76
9	1·40	2	2·80	3	8·40	3	25·20
8	1·42	4	5·68	2	11·36	2	22·72
7	1·42	2	2·84	1	2·84	1	2·84
6	1·33	4	5·32	0	57·04	0	0·0
5	1·25	2	2·50	1	2·5	1	2·5
4	1·12	4	4·48	2	8·96	2	17·92
3	0·96	2	1·92	3	5·76	3	17·28
2	0·71	4	2·84	4	11·36	4	45·44
1	0·46	1½	0·69	5	3·45	5	17·25
½	0·33	2	0·66	5½	3·63	5½	19·96
0	0·0	½	0·0	6	35·66	6	324·62
			37·59				

The Moment of Inertia of L.W.P. about Station 6

$$= 324{\cdot}62 \times \frac{1{\cdot}725}{3} \times 1{\cdot}725^2 \times 2 = 1104{\cdot}6.$$

That is, the sum of the products in column 8 is multiplied by one-third the interval between stations; this result multiplied by the square of the interval between stations, and multiplied again by two for both sides of the float.

A correction has now to be made to determine the moment of inertia about the Centre of Flotation.

The position of the Centre of Flotation is found from the above table by dividing the excess of moments forward (column 6) by the sum of the Functions of Areas and multiplying the result by the interval between stations.

This gives :—

Distance of Cr. of Flotation ford. of Station 6

$$= \frac{57{\cdot}04 - 35{\cdot}66}{37{\cdot}59} \times \frac{1{\cdot}725}{1} = 0{\cdot}98 \text{ ft.}$$

It is about this point we require to find the Moment of Inertia of the Load Water Plane.

If I_0 be M of I about the Cr. of Flotation
and I be M of I about Station 6
and A be Area of Waterplane
and Y be distance between Cr. of Flotation and Station 6.

Then $I_0 = I - A\,Y^2$.

$$\therefore\ I_0 = 1104{\cdot}6 - (41{\cdot}25 \times 0{\cdot}98^2)$$
$$= 1104{\cdot}6 - 39{\cdot}6$$
$$= 1065 \text{ for one float}$$
$$= 2 \times 1065 = 2130 \text{ for both floats.}$$

Then Longitudinal B.M. $= \dfrac{I_0}{V}$

This is indicated on Fig. 2.

Let

x = distance of section — from C.G. of L.W. Plane.
$2Y$ = distance across float at section —
dx = its width
θ = angle of inclination of water-plane (very small)
V = volume of displacement.
v = volume of either wedge.
gg_1 = the distance between their centres of gravity.

Then the volume of prism—

$= 2Y \times X \times dx \times \tan\theta.$

and the moment about P = X × volume

$= 2\,Yx^2\,dx \tan\theta.$

$\therefore$ whole moment of wedges $= v \times gg_1$

$= \int 2\,Yx^2\,dx \tan\theta.$

Tabular Summary.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
No. of Station.	½ Ord. in Feet.	Longitudinal. Metacentre.				Multiplier for M.I.	Products for M.I.	Trans. Meta-centre.	
		G.M.	Functions of Areas.	Lever for Moments.	Moment Product.			½ Ord.³	Products for M.I.
12	0	½		6	0·0	6	0·0	0·0	0·0
11½	0·5	2	1·0	5½	5·5	5½	30·25	0·125	0·25
11	1·0	1½	1·5	5	7·5	5	37·5	1·0	1·50
10	1·34	4	5·36	4	21·44	4	85·76	2·4	9·60
9	1·40	2	2·80	3	8·40	3	25·20	2·74	5·48
8	1·42	4	5·68	2	11·36	2	22·72	2·85	11·40
7	1·42	2	2·84	1	2·84	1	2·84	2·85	5·70
6	1·33	4	5·32	0	57·04	0	0·0	2·35	9·40
5	1·25	2	2·50	1	2·5	1	2·5	1·95	3·90
4	1·12	4	4·48	2	8·96	2	17·92	1·40	5·60
3	0·96	2	1·92	3	5·76	3	17·28	0·88	1·76
2	0·71	4	2·84	4	11·36	4	45·44	0·35	1·40
1	0·46	1½	0·69	5	3·45	5	17·25	0·09	0·135
½	0·33	2	0·66	5½	3·63	5½	19·96	0·036	0·072
0	0·0	½	0·0	6	35·66	6	0·0	0·0	0·0
			37·59				324·62		56·197

Wt. of M/c. = 4,854 lbs.

Reserve Buoyancy = 90 per cent. Minimum.

Displacement in cubic feet $= \dfrac{4854}{64} = 75{\cdot}84.$

Area of Waterplane $\div$ 41·25 sq. ft.

Cr. of Flotation $= \dfrac{57{\cdot}04 - 35{\cdot}66 \times 1{\cdot}725}{37{\cdot}59}$

$= 0{\cdot}98$ ft. ford. of 6.

Longl. M.I. about Stn. 6 $= 324{\cdot}6 \times \dfrac{1{\cdot}725}{3}$

$\times\ 1{\cdot}725^2 \times 2 = 1104{\cdot}6.$

Longl. M.I. about Cr. of Flotation

$= 1104{\cdot}6 - (41{\cdot}25 \times 0{\cdot}98^2) = 1065.$

Transverse M.I.

$$= 56{\cdot}2 \times \frac{1{\cdot}725}{3} \times \frac{2}{3} = 21{\cdot}54.$$

Transverse Metacentre

$$= \frac{(21{\cdot}54 \times 2) + (41{\cdot}25 \times 4{\cdot}5^2 \times 2)}{75{\cdot}84}$$

$= 22{\cdot}5$ ft.

Longl. Metacentre

$$= \frac{2\{1104{\cdot}6 - (41{\cdot}25 \times 0{\cdot}98^2)\}}{75{\cdot}84}$$

$= 28{\cdot}0$ feet.

But $v \times gg_1 = \mathrm{V} \times \mathrm{BB}_1 = \mathrm{V} \times \mathrm{B.M.} \tan\theta$ (practically) ;

$$\therefore \mathrm{V} \times \mathrm{B.M.} \tan\theta = \int 2\,\mathrm{Y}\,x^2\,dx \tan\theta.$$

$$\therefore \mathrm{B.M.} = 2\int \frac{x^2 y\,dx}{\mathrm{V}}$$

Then, as $2\int x^2\mathrm{Y}\,dx$ can be shown equal to the moment of inertia about the centre of flotation, we have :—

$$\mathrm{B.M.} = \frac{\mathrm{I}_0}{\mathrm{V}} = \frac{2{,}130}{75\cdot84} = 28\cdot0 \text{ ft.}$$

$$\therefore \text{longitudinal G.M.} = \text{B.M.} - \text{B.G.}$$
$$= 28\cdot0 - 8\cdot0 = 20\cdot0 \text{ ft.}$$

The fore and aft stability of most seaplanes is usually further checked by calculating the longitudinal G.M. (or metacentric height) with the machine tilted back at an angle of about 8°.

The method adopted is exactly as described already but, of course, involves a new set of calculations for :—

(1) The new displacement to the 8° waterline.

(2) The new position of centre of buoyancy.

(3) The new area of waterplane.

(4) The new position of centre of flotation.

(5) The new moment of inertia of waterplane, about the new centre of flotation.

The distance B.M. in this case will be, of course, much less than when the machine is at normal trim.

In concluding these notes on the methods used to determine the statical stability, a compact tabular summary is given which is in general use, and is of course much handier when one has clearly in mind how to use Simpson's multipliers for each separate calculation.

It will be seen that in this table, calculations

(2) Area of load waterplane ;

(3) Centre of flotation ;

(4) Moment of inertia of load waterplane ;

are worked out side by side.

1. Total displacement of float is, of course, known as soon as the reserve buoyancy is decided on, but must be checked out on the float lines in the manner shown.

5. The displacement to load waterplane is similarly known as soon as the weight of machine is determined, but must also be tried out on the lines to fix the load waterline position and consequently calculations 2, 3 and 4.

It must be added that dynamical stability requires further calculations, and that no account is here taken of changes in weight of machine, say, in a bomber, loaded and riding light, or of changes in trim due to free water surfaces in leaky floats or with compartments flooded.

TECHNICAL LITERATURE.

SUMMARIES OF AERONAUTICAL RESEARCH COMMITTEE REPORTS.

FULL SCALE TESTS OF A BRISTOL FIGHTER WITH SLOT AND AILERON CONTROL OPERATED BY A DIFFERENTIAL LINK MECHANISM.

By H. M. GARNER, M.A. Presented by The Director of Scientific Research.

R. & M. No. 1101 (Ae 279). (2 pages and 2 diagrams.) May, 1927. Price 4*d*. net.

A defect of the slot and aileron controls used hitherto at the Royal Aircraft Establishment has been a jerkiness in the control at high speeds with the ailerons near the normal position. It was thought that this was mainly due to the cam gear employed, and that a differential link system would eliminate the defect.

The link system was fitted to the upper wing of a Mark III Bristol Fighter, and the aeroplane was flown by a number of pilots at the R.A.E.

The jerkiness previously present in the control system was completely eliminated by the alteration in the system, while the effectiveness of the control at the stall was unaltered.

The Bristol Fighter is to be sent to a service squadron for extended trials.

Previous published reports on the slot and aileron control are as follows :—

R. & M. 968. Full scale tests of a new slot and aileron control. By H. L. Stevens.

R. & M. 1051. Second report on full-scale experience with the slot and aileron control fitted to a Bristol Fighter. By H. L. Stevens.

R. & M. 1088. Preliminary report on the fitting of slots and flaps and slot and aileron control to a Bristol Fighter. By H. L. Stevens.

AMERICAN NATIONAL ADVISORY COMMITTEE REPORTS.

The National Advisory Committee for Aeronautics in the United States of America corresponds to our own Aeronautical Research Committee. Two distinct classes of reports are issued, the first being known as *Technical Reports*. These Technical Reports are printed, and are illustrated by photographs and/or drawings. The second class are known as *Technical Notes*, and are issued in mimeographed form so as to enable them to be rapidly distributed to a somewhat smaller, but directly interested, circle of readers. Copies of the Reports and Notes may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.

AMERICAN NATIONAL ADVISORY COMMITTEE TECHNICAL NOTES

The last list of these Notes was published in THE AIRCRAFT ENGINEER of March 31, 1927, to which readers are referred for numbers previous to, and including, No. 253.

T.N. No. 254 :—"METHOD OF CORRECTING WIND TUNNEL DATA FOR OMITTED PARTS OF AIRPLANE MODELS."

By R. H. Smith, Department of Construction and Repair, Washington Navy Yard.

The title of this Note is considered to be sufficient indication of the subject-matter, and no summary will, therefore, be given.

T.N. 255 :—"PRECISION OF WING SECTIONS AND CONSEQUENT AERODYNAMIC EFFECTS."

By Frank Rizzo, Langley Memorial Aeronautical Laboratory.

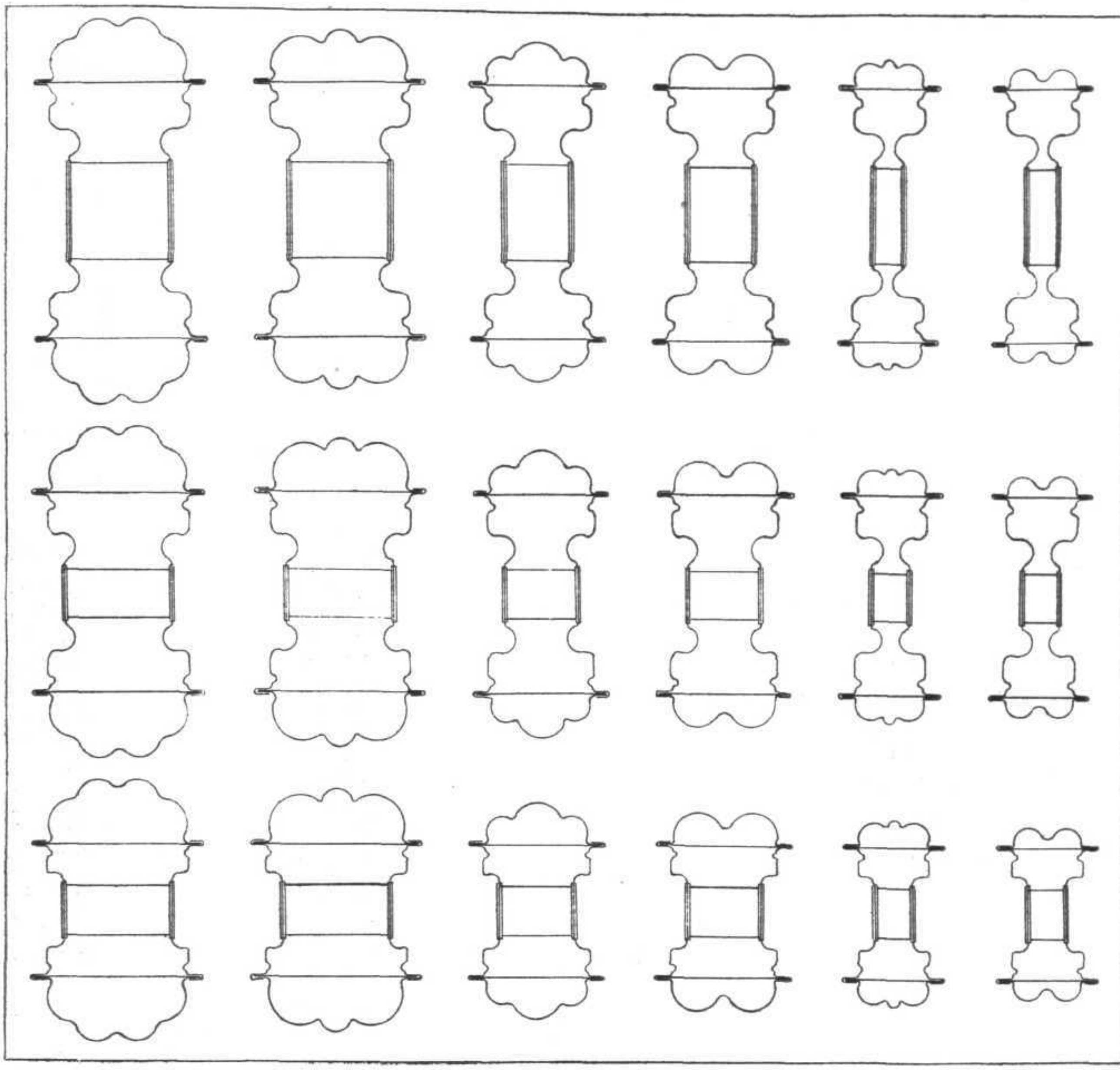
This investigation was carried out by the N.A.C.A. at the Langley Memorial Aeronautical Laboratory to determine the precision of wing sections of wood-fabric construction used on a number of aeroplanes. It was found that all wing sections deviated more or less from their respective prototypes. The mean thickness of the section was computed for those wings with a noticeable sag. The aerodynamic effects resulting from consideration of thickness variation are then estimated from existing empirical information. The rib, sag and specified measurements of 14 sections investigated are given in Fig. 2.

T.N. No. 256 :—"WALL INTERFERENCE IN CLOSED-TYPE WIND TUNNELS." By George J. Higgins, Langley Memorial Aeronautical Laboratory.

A series of tests has been conducted by the N.A.C.A. in the variable density wind tunnel on several aerofoils of different sizes and sections, to determine the effect of tunnel wall interference and to determine a correction which can be applied to reduce the error caused thereby. The use of several empirical corrections was attempted with little success. The Prandtl theoretical correction gives the best results, and its use is recommended for correcting closed-type wind tunnel results to conditions of free air.

T.N. No. 257 :—"TECHNICAL PREPARATION OF THE AEROPLANE 'SPIRIT OF ST. LOUIS'." Written for the N.A.C.A. by Donald A. Hall, Chief Engineer, Ryan Airlines, Inc.

In the main, this Note contains the same information concerning Col. Lindbergh's famous machine as that published in FLIGHT of June 9, 1927. Additional data are, however, given.



BOULTON & PAUL STANDARDISED SPAR SECTIONS : Three types of webs and six types of flanges give a combination producing 18 distinct spars. By altering the gauge, and the material (even to the substitution of Duralumin for steel), a very wide range is obtained.

Boulton & Paul "Sidestrand I"

(*Concluded from p.* 212.)

Speed at 10,000 ft. (3,050 m.), 129 m.p.h. (207·7 kms./hour).
Speed at 15,000 ft. (4,570 m.), 122 m.p.h. (196·5 kms./hour).
Landing speed (engine off), 51 m.p.h. (82 kms./hour).
Landing Speed (engine on), 47 m.p.h. (76 kms./hour).
Climb to 10,000 ft. in 10·5 mins.
Climb to 15,000 ft. in 19 mins.
Service ceiling, 21,500 ft. (6,560 m.).
Absolute ceiling, 23,000 ft. (7,000 m.).

Full-throttle range at operational height, 750 miles (1,200 kms.). The actual range at economic speeds is, of course, considerably higher.

Everling Quantities

High-speed figure $\frac{\eta}{2k_D} = 16$

Distance figure $\eta \frac{L}{D} = 3\cdot5$.

Altitude figure $\eta \frac{L}{D} \sqrt{2k_L} = 6\cdot25$.

These values are unusually high for a twin-engined biplane, and appear to bear out the claims for high aerodynamic efficiency. For instance, if a propeller efficiency of 75 per cent. is assumed at top speed, the "absolute" drag coefficient of the whole machine at top speed works out at $\frac{0\cdot75}{32} = 0\cdot023$ a value well above the average for a machine of this type.

Great Aerial Film

At the Carlton Theatre, Haymarket, London, there is shown a wonderful film entitled "Wings." It depicts the career of American airmen during the war from the training stage to the realities of war in the air in France. The air fighting and bombing scenes are most thrilling, owing to photographic ingenuity, which gives the audience the illusion that they are flying in the machines and engaged in the fighting. Sustained orchestral effects synchronising faultlessly with crashes, bomb explosions and the spinning dives of defeated machines, add to the marvellous illusion. "Wings" is a film that will raise a new thrill in hardened cinema "fans." It is a masterpiece of its kind, and has aroused the approval of Col. Bishop, V.C., who brought down over 70 machines during the war.

R.A.F. Sport

THE R.A.F. cross-country championship was decided at Henlow Camp on March 21, when A/c F. W. Turner (Uxbridge), the Middlesex champion, retained the individual title, A/c R. H. Thomas (Henlow) was second. The senior team championship was won by Uxbridge.

PRIVATE FLYING

A Section of FLIGHT in the Interests of the Private Owner, Owner-Pilot, and Club Member

FLYING IN CANADA

Club Movement and Air Survey

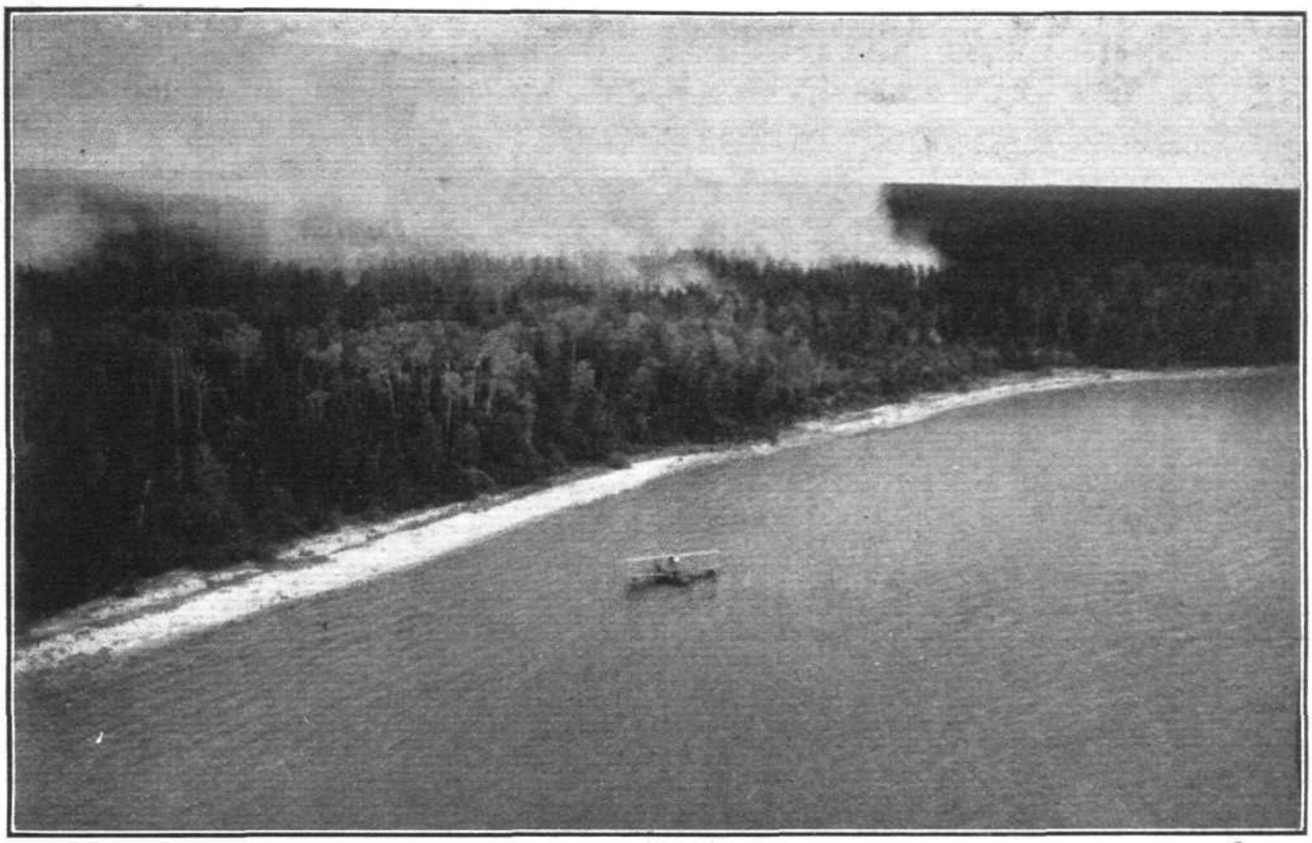
Victoria

THE influence of the flying club movement is spreading to the farthest corners of the globe. The organisation adopted is often an emulation of that which prevails in England, which becomes natural when it is found that in many instances the organisers or instigators are well-known English pioneers of aviation, or whatever their aviation experience it was obtained here; invariably during the war. A case in point is that at Victoria, British Columbia, where a flying club has been formed recently with Mr. Sydney Pickles as its honorary secretary. He is the Australian pilot who was well known in this country during the war and before the war. It was in 1912 that he obtained his pilot's certificate, No. 263, and served as assistant instructor at the Bristol School, and chief instructor at the Ewen School, Hendon. He became a Flight-Lieutenant, Royal Naval Air Service, when hostilities commenced, saw active service under Commander Sampson in France, became chief instructor at Eastchurch, and a seaplane and flying-boat instructor at Calshot. During his career he has flown over 7,000 hours. On returning to Australia, he followed the profession again in the year 1919-1920, but as, at that period, there was very little expansion in Australian aviation, he sold his machine and temporarily retired from flying. Then he went to settle in British Columbia with his family, and the beginning of a flying club at Victoria immediately fired his enthusiasm and his present position followed. His services for the club both as instructor, secretary and treasurer, will be voluntary in order to lighten its burden during the initial stages. Other qualified instructors will assist him. The directors have considerable experience of aviation, mostly as pilots. Mr. A. V. Carter, M.B.E., D.S.C., late Capt., R.A.F., is the President. He learned to fly in 1916 and saw service in France. As Air Station Supt. he was attached to the Canadian Air Board, and is now a certified commercial pilot and ground engineer. Mr. Awde, Flight-Lieut., R.A.F. (retired list), a director, learned to fly in 1917, served in France with 56 Squadron, passsed through a special instructor's course at Gosport, became instructor at the Central Flying School, Upavon, and later a test pilot in the R.A.F. Mr. L. de S. Duke, late Capt., R.A.F., holds the D.F.C. and saw service in France.

Mr. R. H. B. Ker, late Maj., R.A.F., learned to fly in 1915, and was in command of a training squadron at Camp Borden, Ontario, after serving in France. He is now a prominent business man in Victoria. Mr. J. Gray, B.Sc., Toronto University, late Capt., R.A.F., learned to fly in 1917, served as instructor at Mohawk, Canada, went to France with 27 Squadron, and subsequently did test work at Martlesham. In 1919 he did a lot of flying round Victoria in connection with the old Aerial League. Mr. W. L. Stewart Macleod, is also a member of the London Aeroplane Club, which he joined in 1926. The other directors are Mr. Evan Hanbury, late Lieut., R.A.F., holder of the M.M.; Mr. E. Eve, President of the B.C. Airways Co., Ltd.; and Mr. G. Cameron, late R.A.F., a lawyer.

In a fortnight, 38 flying members joined the club. The Dominion Government's gift of two light aeroplanes is hoped for by May, in order to commence flying instruction. This official scheme allows such a grant to any properly constituted organisation having a minimum membership of 30.

A CANADIAN AIR STATION: An ideal natural harbour for seaplanes; the R.C.A.F. Air Station at Victoria Beach, Manitoba. Photo reproduced through courtesy of the Office of the High Commissioner for Canada.



AERIAL FIRE FIGHTING IN CANADA : Our picture, which we reproduce through the courtesy of the office of the High Commissioner for Canada, shows a forest fire near Lake Winnipeg, Manitoba, with one of the suppression aircraft (a Vickers flying-boat) of the R.C.A.F. standing by.

In countries like Canada, Australia and South Africa, where commercial aviation has a great future, it is often the existence of the flying club which draws attention to the town in which it is located as a possible airport. They collect data of a minor importance which indicates future possibilities. We have at least one example of this effect in England. Before we had a flying club at Norwich, no mention of the geographical advantages of that town for a future airport was ever made, but now at nearly every public meeting of the club experts are continually forecasting its future in this direction.

So at Victoria, British Columbia, the local club is boosting the town likewise. Mr. Pickles says that it should become Canada's Pacific Airport. The club is appealing for public support in the matter. It is suggested locally that Victoria is the logical site because of its climatic and geographical advantages. It is the last port of call for shipping bound for Australia and the Far East, and likewise the first port of call for inbound shipping. Travellers who missed their boat at Vancouver on the mainland could catch it by flying to Victoria, which is the southerly point of Vancouver Island and south of Vancouver. This facility would also apply to delayed mail and express freight. It is hinted, too, that not only Canadian traffic could be expected, for the proximity of Victoria to the United States makes possible another avenue of traffic. The air traffic in America is rapidly increasing. It is now possible to fly direct from Chicago to San Francisco, join an air connection there, and reach Seattle, which is not far from Victoria, in a south-easterly direction. In the near future, it is suggested, this southern air route to San Francisco may be substituted with a more direct northerly route for passengers wishing to reach Victoria from New York. The course taken would be via the Eastern States, Seattle and Chicago. This would make a quick trip for the New Yorker who wished, say, to board the Empress of Canada at Victoria for Yokohama. Mention is also made of Victoria's position in connection with the Empire Airship scheme, as the shortest route from Canada to Australia is via that city.

Both aeroplanes and seaplanes can be easily operated from Victoria. Already there is one aerodrome prepared whilst adjoining it is another suitable site. For flying-boats or seaplanes, the Esquimalt and Victoria harbours and the Cadboro Bay are available. The climate is spoken of as good nearly all the year round, and there is a comparative freedom from fog. It apparently escapes lightly from heavy rains, hail and snow. South-west breezes blow consistently but seldom are they strong enough to interfere with flying.

Vancouver

Aviation is equally active and promising at Vancouver. A club has been formed, writes a correspondent to FLIGHT, and the usual grant from the Government of two machines, which will probably be D.H. "Moths," is expected by April. The president of the club is the well-known Canadian war-time "ace," Maj. D. R. MacLaren, D.S.O., M.C., and bar, D.F.C. The club is altogether fortunate in its officials, for besides Maj. MacLaren it has as its vice-president, Maj. A. D. Bell-Irving, M.C., formerly a flying instructor at Gosport, and as its secretary, Capt. Leonard Miller, a former member of 55th Squadron, R.F.C., and R.A.F. With such experienced leaders no club has so much promise. About 200 members have been enrolled. A flying instructor and ground engineer, both of whom must possess licences granted by the Canadian Air Board, will be engaged.

Incidentally, two private air companies operate at Vancouver, which has a population of approximately 300,000 people. They are Pacific Airways, Ltd., of which Maj. Mac Laren, mentioned above, is the head ; and Dominion Airways, Ltd., which has Capt. E. C. W. Dobbin as operation manager. The former uses an HS2L flying-boat fitted with a 400 h.p. Liberty engine ; and the latter a D.H. "Moth" seaplane fitted with a Mark II Cirrus engine. Vancouver is establishing a municipal aerodrome. The club is the first in British Columbia and known as the Aero Club of British Columbia, Vancouver branch.

Canadian Air Survey

Aviation in Canada has found its greatest outlet in aerial survey. Aerial photography was inaugurated there about six years ago by the Topographical Survey, Department of the Interior, working in co-operation with the Royal Canadian Air Force, Department of National Defence. During 1927 a total of 45,850 sq. miles of territory was photographed, of which 28,650 sq. miles was by oblique photography and 17,200 sq. miles by vertical photography. The oblique photographs numbered 16,246 and the vertical photographs 46,340. In eight of the nine provinces the work was carried out.

Individual operations included such big jobs as the extension of oblique photographs over an area of 15,200 sq. miles west of Lake Winnipeg for forestry purposes ; and oblique photography covering an area of 8,000 sq. miles over the Wood

Buffalo Park near Fort Smith, N.W.T. ; also a considerable number of vertical photographic operations on smaller individual areas throughout various parts of Canada.

The survey over the 15,200 sq. miles west of Lake Winnipeg was undertaken at the request of the Forest Service of the Department of the Interior, to assist in the location of timber for pulp purposes. Photographs were taken in the early summer, the prints were made immediately afterwards at Ottawa, and timber type maps prepared on scales of 2 in. to the mile, two miles to the inch, and also four miles to the inch.

The maps were quickly forwarded to the forest officer in charge of the timber cruising in the field. The data rendered possible the elimination of operations of extensive tracts of non-timbered country and a concentration of activities on areas of commercial value. It was thus possible to cruise the entire area in one season which, without the photographic maps, it would have been impossible to do in the time. One of the interesting contracts completed during the season was the covering by vertical photographs of the route of the New Welland canal through the Niagara Peninsula. It was operated at the request of the Department of Railways and Canals for the purpose of showing the progress of the work in pictorial form. When a comparison was made with photographs of the same area taken in 1921 the advance made was easily observed.

Niagara Falls was also photographed both vertically and obliquely at the request of the Dominion Water Power and Reclamation Service for the study of various features relating to the effect of ice conditions and the recession of the brink of the falls.

A final item of interest about Canadian aviation is that Western Airways, Ltd., of Winnipeg, which carries on extensive commercial flying operation in Manitoba, has now added considerably to its fleet of aircraft by the purchase of 12 Fokker "Universal" monoplanes, for operating in the Province.

Western Canada Airways have been providing transportation service to the mining fields and in addition to moving men and supplies has moved much materiall for development purposes, such as diamond drills.

LIGHT 'PLANE CLUBS

London Aeroplane Club, Stag Lane, Edgware. Sec., H. E. Perrin, 3, Clifford Street, London, W.1.
Bristol and Wessex Aeroplane Club, Filton, Gloucester. Secretary, Capt. C. F. G. Crawford, Filton Aerodrome, Patchway.
Hampshire Aero Club, Hamble, Southampton. Secretary, H. J. Harrington, Hamble, Southampton.
Lancashire Aero Club, Woodford, Lancs. Secretary, C. J. Wood, Oakfield, Dukinfield, near Manchester.
Midland Aero Club, Castle Bromwich, Birmingham. Secretary, Maj. Gilbert Dennison, 22, Villa Road, Handsworth, Birmingham.
Newcastle-on-Tyne Aero Club, Cramlington, Northumberland. Secretary, A. H. Bell, c/o The Club.
Norfolk and Norwich Aero Club, Mousehold, Norwich. Manager, F. Gough, The Aerodrome, Mousehold, Norwich.
Nottingham Aero Club, Hucknall, Nottingham. Hon. Secretary, Cecil R. Sands, A.C.A., Imperial Buildings, Victoria Street, Nottingham.
The Scottish Flying Club, 101, St. Vincent Street, Glasgow. Secretary, Harry W. Smith.
Southern Aero Club, Shoreham, Sussex. Secretary, C. A. Boucher, Shoreham Aerodrome, Sussex.
Suffolk Aeroplane Club, Ipswich. Secretary, Courtney N. Prentice, "Hazeldell," Stowmarket, Suffolk.
Yorkshire Aeroplane Club, Sherburn-in-Elmet, Yorks. Secretary, Lieut.-Col. Walker, The Aerodrome, Sherburn-in-Elmet.

LONDON AEROPLANE CLUB

REPORT for week ending March 25.—Flying time, 34 hrs. 15 mins. Dual instruction, 23 hrs. 35 mins. Solo flying, 10 hrs. 40 mins.

Dual instruction (with Captain F. G. N. Sparks) : G. Black, Mrs. P. Fraser, Miss D. Fletcher, H. W. Marlow, L. Rowson, A. G. G. Marshall, J. P. Edinger, Major R. M. S. Veal, W. H. Lane, Miss H. Cholmondeley, H. Sutton, Miss M. Wilson. (With F. R. Matthews) : A. G. G. Marshall, A. O. Wigzell, A. L. Petty, D. Schreiber, J. A. Crane, W. H. Lane, R. Ward, C. Peckham, E. Clarkson, H. W. Marlow, S. O. Bradshaw, J. A. Murphy, Miss M. Wilson, Miss D. Fletcher, J. C. Watson, H. Sutton, Mrs. Guest, Miss H. Cholmondeley, E. R. Andrews.

Solo flying : R. Sanders Clark, G. C. Bonner, H. M. Samuelson, P. W. Hoare, Major Beaumont, B. B. Tucker, J. H. Saffery, O. J. Tapper, G. H. Craig, G. W. Hall, E. E. Stammers, W. Hay, E. E. Fresson, C. E. Murrell, Major R. M. S. Veal, A. R. Ogston, W. L. M. O'Connor, Miss D. Fletcher, A. F. Wallace, J. J. Hofer, Miss W. E. Spooner.

Passenger flights (with O. J. Tapper) : G. H. Craig. (With G. H. Craig) : S. O. Bradshaw. (With F. R. Matthews) : Mrs. Davis, T. A. Eden. (With Will Hay) : S. M. Nesbitt. (With A. R. Ogston) : B. Waugh. (With J. J. Hofer) : Will Hay.

BRISTOL & WESSEX AEROPLANE CLUB

REPORT for week ending March 24.—Total flying time, 27 hrs. 20 mins. Dual instruction, 13 hrs. 15 mins. Solo instruction, 9 hrs. 20 mins. Passenger flights, 2 hrs. 45 mins.

Instruction (with Mr. Bartlett) : Messrs. Tanner, Garnett, Hall, Roberts, B. L. Bathurst, Kennan, Hughes, Girdlestone. (With Mr. Tratman) : Mr. Hall.

Soloists : Messrs. Arnold and T. H. Clarke.

Cross-country flights : Mr. Bartlett and Mr. Tanner to Stag Lane and Croydon. Mr. Downes-Shaw to Maidenhead and to Cardiff.

Passengers (with Mr. Tratman), 3. (With Mr. Downes-Shaw), 4. (With Mr. Bathurst), 2. (With Mr. Bartlett), 1. (With Mr. Hopper), 1. Total passengers, 11.

Although we sent off three machines to Croydon on Wednesday for the review by the King of Afghanistan, one only was present. Mr. Downes-Shaw in his private Moth and Messrs. Tratman and Hall in a Club machine were stopped by very thick weather on Wednesday morning and turned back at Badminton. Mr. Bartlett, who took Mr. Tanner with him, flew to Stag Lane on Monday and proceeded to Croydon from there on Wednesday morning.

We are hoping that the weather will be kind to us on the day of our pageant so that a large attendance will be assured.

HAMPSHIRE AEROPLANE CLUB

REPORT for week ending March 25.—Solo flights, 8 hrs. 25 mins. Dual, 10 hrs. 35 mins. Passenger flights, 1 hr. Tests, 40 mins. Total flying time, 20 hrs. 40 mins.

Instruction (with Flight-Lieut. Swoffer), 11. Passengers (with Flight-Lieut. Swoffer), 3. Soloists, 11. Passengers (with Capt. Kirby), 1.

Mr. Shepherd successfully carried out the tests for his "A" Licence.

We are very pleased to state that we have a number of new flying pupils, but owing to the weather being so unkind to us this week, it has seriously affected our flying activities.

LANCASHIRE AERO CLUB

REPORT for week ending March 24.—Flying time, 23 hrs. 5 mins. Instruction, 8 hrs. 10 mins. Solo flights, 7 hrs. 45 mins. Passenger flights, 6 hrs. 15 mins. Tests, 55 mins.

Instruction (with Mr. Baker) : Benson, Tweedale, Hartley, Sykes, Harrison, Weale, Miss Hill, Eills, Mills, Riley, Goss, Gort, Garner, Chart, Slack, Mason, Cohen, Heath, Watson, Pattreious. (With Mr. Cantrill) : Miss Baerlein.

Soloists (under instruction) : Cohen, Hall, Brooking, Ruddy, Miss Baerlein, Benson, Gort.

Pilots : Meads, Cantrill, Harber, Twemlow, Browning, Lacayo, Leeming, Crosthwaite, Nelson, Hardy, Davison, Wade, Heath.

Passengers (with Mr. Lacayo) : Miss Wood. (With Mr. Goodfellow) : Mills, D. R. Goodfellow, Mrs. Hoole, Mrs. Wood. (With Mr. Meads) : Benson, Perridge. (With Mr. Scholes) : Sellers, Goss, Mee, Mrs. Faulkner. (With Mr. Williams) : Hendrie, Hindle, Miss Lodge. (With Mr. Dobson) : Hughes.

Wet and stormy weather has restricted flying, but despite this Mr. Benson managed to get in an excellent first solo, while Mr. Cohen completed the tests for his "A" Licence. Miss Baerlein, who has not flown since her accident last September, went off again this week and put up a very good show.

Messrs. Goodfellow and Mills flew over to Blackpool on Monday to meet the Council and discuss the lay-out of enclosures. They had a rough passage both ways, the return journey taking nearly two hours against strong head winds and rain.

We offer our deepest sympathies to Miss Win Brown over her accident on Sunday at Dukinfield.

MIDLAND AERO CLUB LIMITED

REPORT for week ending March 24.—Total flying time, 12 hrs. 20 mins.

Dual instruction (with Flight-Lieut. Rose, D.F.C.), H. Tipper, G. Aldridge, H. D. Coleman, J. R. H. Baker, S. Duckitt, E. D. Wynn, S. G. Hall, W. Scott, W. Swann.

Solo : W. Swann, H. R. King, E. D. Wynn, R. D. Bednell, S. H. Smith.

Passengers, with Flight-Lieut. Rose : Miss Lane, M. Turner, A. Harley. With Mr. Swann, N. Crane. With Mr. Brighton : J. E. Hicks. With Mr. Jackson : Mrs. Harley, J. H. Moore, H. Beamish. With Mr. Willis : Mrs. Willis.

NEWCASTLE-UPON-TYNE AERO CLUB

REPORT for week ending March 25.—Total flying time, 20 hrs. 30 mins. Instruction, 5 hrs. 15 mins. ; solo training, 1 hr. 45 mins. ; "A" pilots, 12 hrs. 15 mins. ; tests, 1 hr. 10 mins. ; joyrides, 5 mins.

The following members flew under instruction with Mr. Parkinson.—Messrs. Floyd-Brown, Runciman, Horn, White, Percy, E. J. Griffiths, Brooks, Cochrane-Carr, Dr. Alderson.

Soloists.—Messrs. Floyd-Brown, W. L. Runciman, Percy, De Pledge, N. Horn.

"A" Pilots.—Mrs. Heslop, Messrs. C. Thompson, R. N. Thompson, F. L. Turnbull, H. Ellis, J. Stewart, R. M. Stobie, F. H. Phillips, P. Forsyth Heppell, Lord Ossulston, Dr. H. B. L. Dixon, Miss C. R. Leathart, Messrs. D. Wilson, A. Bell.

Passengers (with Mrs. Heslop) : Mr. C. Thompson. (With Mr. C. Thompson) : Mrs. Heslop, Mr. Luckman. (With Mr. F. L. Turnbull) : Mr. R. N. Thompson. (With Mr. H. Ellis) : Mr. White, Mr. Pollock.

Mr. Floyd-Brown and Mr. W. L. Runciman carried out their first solos in excellent style during the week.

Lord Ossulston brought his new "X" Moth from Stag Lane on Thursday, going on to Chillingham later. He returned to fly in the Landing Competition on Sunday.

The Landing Competition for the Pearce-Thorn Trophy took place on Sunday and was very successful. Mr. F. Howard Phillips was the winner, Mr. A. Bell second, and Mr. Forsyth Heppell third.

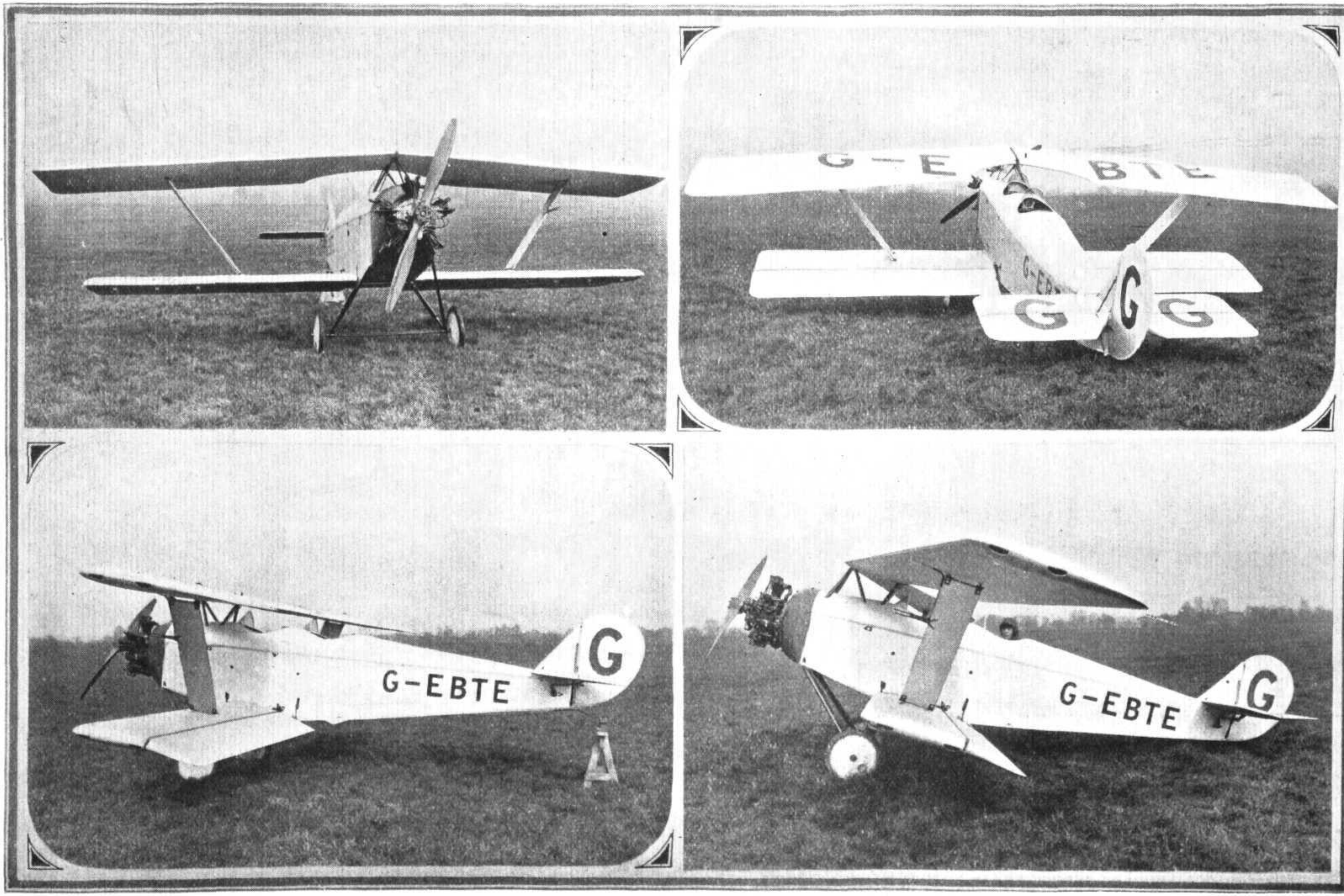
The weather during the week was again bad, Thursday and Sunday being the only days upon which flying was possible.

NORFOLK & NORWICH AERO CLUB

REPORT for week ending March 24.—Total flying time, 8 hrs. 25 mins.

Instruction with Mr. Fry.—Messrs. G. Barker, E. Bougrat, E. Lambert, C. Browne, E. Varden Smith, A. J. K. Finch.

Soloists.—Messrs. G. F. Surtees, H. Mack, R. F. Potter, W. P. Cubitt, F. Gough, A. W. Ramsay.



A NEW LIGHT AEROPLANE: The Parnall "Imp" with Armstrong-Siddeley "Genet" engine is of somewhat unorthodox design. The top plane has a pronounced sweep-back, and the wings are cantilevers. The wing arrangement was evidently chosen so as to give a good view from both cockpits.

Passengers.—Messrs. P. Pickthorne, G. Lambert, A. Stevens.
Mr. G. Barker of Lowestoft went off solo in fine style on Saturday.
The week of bad weather has kept our flying time very low this week, and we overhauled the machines very thoroughly so they are both in fine trim for a good time (we hope) this week.
Public flying starts Thursday next, and very cheap trips will be given to the public who care to avail themselves of the opportunity. We expect a large crowd.

NOTTINGHAM AERO CLUB

REPORT for week ending March 23.—Total flying time, 16 hrs. 50 mins Dual, 8 hrs. 50 mins.; solo ("A" licence), 4 hrs. 35 mins. Solo (under instruction), 1 hr. 45 mins. Tests, 45 mins. Passenger flights, 55 mins.
Passenger flights: With Mr. Martin: Miss Murdock, Messrs. J. Granger, A. Williams, W. Hardstaff, A. Macashill, H. Phillips, and T. Bryant. With Mr. Hallam: Miss Morley, Mrs. Willatt. With Mr. Seely Whitby: Miss Marsh and Miss Hall. With Mr. Wilcox: Mr. Walter. With Mr. Blake: Mr. K. Blake. With Mr. Cyril Sands: Mr. Ramsay Cox. With Mr. Paul: Mr. Waring. With Mr. Ball: Mr. Hainson.
Dual, with Mr. Martin: Messrs. F. Granger, A. Calladine, Bradley, Lucas, Walter, Hancock, Glenn, Ashworth, Stevenson, Dawson and Lazzerini.
Solo "A" licence: Messrs. Hallam, Wilcox, Whitby, Cox, Cyril Sands, Blake, Paul and Ball.
Solo (under instruction): Messrs. E. Pilgrim and F. Granger.
Visitors: On Friday, the 23rd, Messrs. Warwick, of Air Taxi's, and Casey of *Daily Mirror*.

SOUTHERN AERO CLUB

REPORT for week ending March 19.—Flying time, 19 hrs. 30 mins. Dual, 10 hrs; solo, 3 hrs. 30 mins.; passengers, 6 hrs.
This has been a very quiet week for some reason, very few pupils having put in an appearance, in spite of good weather. Mr. R. S. Moore, the Assistant Secretary of the Club, went to Edinburgh to represent the Gnat Aero Company at the inaugural meeting of the Edinburgh Aero Club. He tells us that he thinks that though not first in the field in Scotland, when once they get started they will be a very strong club, so much for the "canny Scot."
REPORT for week ending March 26.—Flying time, 20 hrs. 10 mins. Dual, 7 hrs.; solo, 3 hrs. 10 mins.; passengers, 10 hr.
On Wednesday, Mr. Miles took the Vice-President and Secretary of the Tunbridge Wells Club to Croydon for the visit of the King of Afghanistan; the flight was made on the Club Avro, 'VL.

SUFFOLK AEROPLANE CLUB

REPORT for week ending March 25.—Flying time, 12 hrs. 5 mins.
Instruction with Mr. Lowdell.—Miss D. Creasy, Miss S. Edwards, Miss G. Rhodes, Dr. Dunn, Messrs. Schofield, Billinton, Peck, Hanson, Verney.
Soloists.—Miss Sylvia Edwards, Dr. Sleigh, K. Peck, R. Brown, S. Schofield, C. Prentice. Passengers.—10.
The telephone is now installed at the aerodrome, Hadleigh 57.
On Wednesday, our instructor with Mr. Verney as passenger, flew to Croydon in Bluebird G.EBRE for the inspection by the King of Afghanistan.
The "On to Hadleigh" Rally. We have received a large number of entries for this rally, also quite a number of people who are not yet sure of their plans have asked for an extension of the closing date of this. Pilots can now enter as late as Saturday, April 7, providing we receive a telegram stating point of departure, make of machine, and registration number.
SPECIAL NOTE.—All pilots flying from Lympne and East Kent are to fly to Hadleigh via Sutton Farm Aerodrome, nr. Hornchurch, Essex. They are to fly over Sutton Farm Aerodrome at a height of not more than 100 ft. so that the official observer can note registration marks. This course has been adopted to avoid crossing the mouth of the Thames.
The finishing line at Hadleigh is a track across the aerodrome, running north and south, machines arriving are to cross this from west to east.

YORKSHIRE AEROPLANE CLUB

REPORT for week ending March 24.—Flying time, 13 hrs. 15 mins. Instruction, 8 hrs. 40 mins.; soloists, 3 hrs. 55 mins.; passengers, 40 mins.
Instruction (with Capt. Beck): Messrs. Ambler, Brown, Cooke, Crowther, I., Crowther, H., Dane, Humpheries, Ostler, Dick. (With Mr. Stockbridge): Mr. Ostler.
Soloists.—Messrs. Brown, Humpheries, Dick.
"A" Pilots.—Messrs. I. Thomson and Wood.
Passengers (with Capt. Beck): Miss Hardwick. (With Mr. I. Thomson): Capt. West, Messrs. Humpheries, Dick.
Flying took place on three days only this week, namely, Sunday, Friday and Saturday. This was due to heavy winds, rain and mist.
A new member, just out of the service, joined us this week, namely, Mr. Stewart Dick.
SV is over at Brough for further modifications, in the meantime the Blackburn Aeroplane Co., have lent us TA so that we are working with two serviceable machines. We hope in the near future to have RG replaced, and thus accommodate our flying members during the oncoming light evenings.

FROM THE FLYING SCHOOLS

The De Havilland Flying School, Stag Lane Aerodrome

REPORT for week ending March 25.—Total flying, 108 hrs. 50 mins. Instruction: dual, 42 hrs. 30 mins.; solo, 55 hrs. 10 mins. Other flying, 11 hrs. 10 mins.
Slightly improved weather conditions and longer evenings have led to a considerable increase of the work of the the school during the past week.
Three first solos were carried out, the pupils including Mr. F. St. Barbe, who on Saturday did his second first solo, after a standard course of instruction, albeit spread over a long period. His first effort was some five or six years ago, and was the result of a somewhat intensive course of lessons, associated with a wager.
Two pupils also satisfactorily passed their "A" licence tests. Six new "Moths" and the repaired "Hound" were also tested during the week.
During the week a number of Cambridge undergraduates also reported for "ab initio" training in the Royal Air Force Reserve.

Henderson Flying School, Ltd., Brooklands Aerodrome.

REPORT for week ending March 22.—Total, 17 hrs. 35 mins. Solo, 3 hrs. 25 mins dual, 14 hrs. 10 mins.
Dual (with Mr. H. D. Davis): Messrs. Jonassen, Davies, Whitley, Whithard, Habsburg, McCabe, Worley, H'Siao, Mills and Dr. Wall.
Solo: Messrs. Habsburg, McCabe, Whitley, Liniker, Crabtree and Dr. Wall.
Dual (with Mr. A. E. Golds): Van Gessel and Dr. Forcythe.
Although the flying time was low owing to bad weather, we have been able to launch Mr. Habsburg and Mr. Whitley "solo."
Dr. Wall was sent up for his height test on the 22nd, and after he had left the ground his instructor was informed by one of the pupils that Dr. Wall was out to break the school height record.
He continued flying well after sun had set and landed in semi-darkness. At the time we were worried about him breaking the rules and regulations, but as the flight was carried out very satisfactorily, no further comments were made. Dr. Wall has now passed his air test for his R.A.C. Certificate.
The following are new pupils: Messrs. Davies and H'Siao.

Lieut. Kinkead's Death.

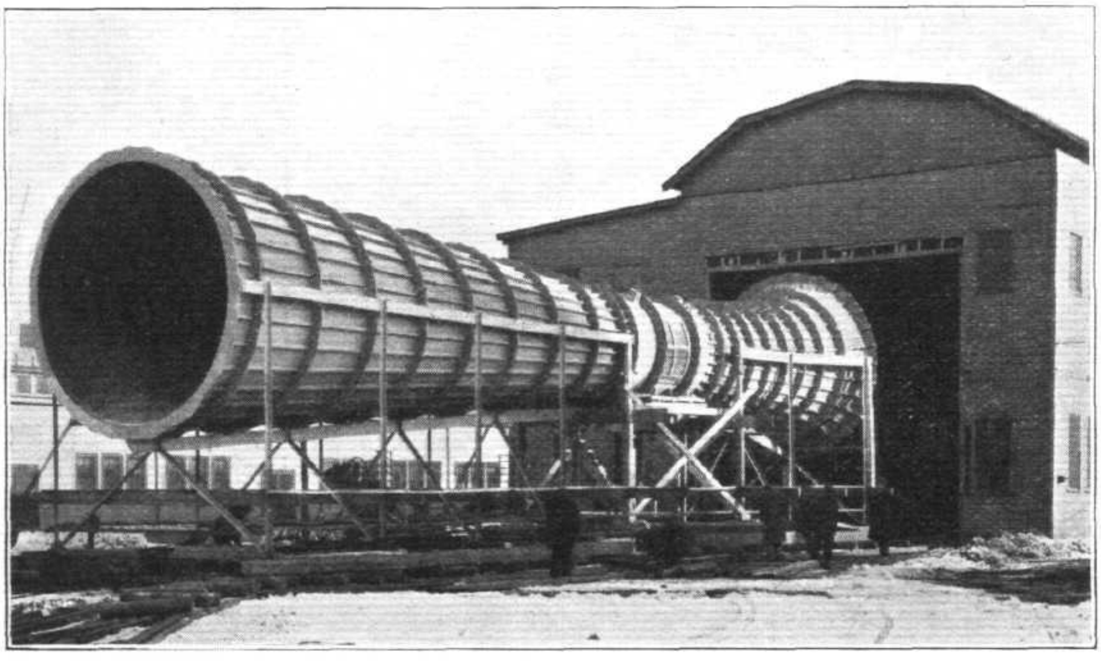
AT the resumed inquest on Flight-Lieut. Kinkead at Calshot, on March 26, it was stated that medical investigation proved that there was no evidence of petrol fume poisoning to account for his death in the crash of the Supermarine-Napier S5, on March 12. The inquest was again adjourned until April 20.

Strike at Howden

WORK on the new rigid airship, R100, at Howden, Yorkshire, was held up for a short time last week owing to a strike of fitters and riggers, The dispute concerned the premium bonus sytem, which the fitters alleged resulted in lower payment than the recognised standard rate. Work was resumed on Monday, March 26, on the understanding that the question would be discussed with responsible officials.

The Royal Air Force Memorial Fund

THE usual meeting of the Grants Sub-Committee of the Fund was held at Iddesleigh House, on March 22. Lieut.-Comm. H. E. Perrin was in the chair, and the other members of the Committee present were Mrs. L. M. K. Pratt-Barlow, O.B.E., Mr. W. S. Field, Sqdn.-Ldr. Douglas Iron, O.B.E. The Committee considered in all 11 cases, and made grants to the amount of £116 3s. The next meeting was fixed for April 3, at 2.30 p.m.



Not a Giant Flower Vase: But one of the two large wind tunnels employed in the department of aeronautical engineering at the Massachusetts Institute of Technology. This tunnel, which is 81 ft. long, 7 to 15 ft. in diameter, is shown being moved from a temporary building to its permanent home in the new Daniel Guggenheim Aeronautical Laboratory.

DEBATE ON THE AIR ESTIMATES

WE continue below the debate on the Air Estimates in the House of Commons on March 12, the first part of which was published in last week's issue.

On the report of Vote "A" for a maximum number of 32,500 officers and airmen to be borne on the establishment of the R.A.F., exclusive of those serving in India, **Lieut.-Comdr. Kenworthy** (Hull Central—U.) moved to reduce the vote by 100 men. He said the Secretary of State for Air was doing nothing to educate and encourage our great municipalities to set up aerodromes, and that the great majority of the Service aerodromes, etc., were not well placed—the main aerodromes and landing grounds should be well north of the central line of England. Regarding "freedom of the air," he suggested that the reasons why we had not been able to obtain permission from Persia to fly over their country was because we refused to allow a German-Russian company to run to Baghdad, and in the case of the air route to Prague, Germany would not allow us to fly over their territory because they had certain grievances as to the application of the air clause of the Treaty of Versailles. Referring to Iraq, he said that in the ordinary direct warfare (camel raiding) women and children were not killed, and suggested that the raids recently reported started with strikes on our side of the frontier—the Wahabi raids being retaliations. He hoped that the air arm in the desert would be used with the greatest possible restraint.

Sir Samuel Hoare, replying, first referred to the fatal accident to Flight-Lieut. Kinkead (news of which had just been received) and offered the sympathy of the House to the members of this officer's family. Regarding the positions of our aerodromes, he could only say that they had selected the sites after the most careful consideration of the strategical interests involved. He pointed out that it was necessary to have them sufficiently near any possible scene of operations to make machines and personnel available in time of national emergency. They had, he thought, held the balance between the two needs. As regards the question of flying over Persia, he assured the House that the desire of a German company to fly to Baghdad had, so far as his information went, nothing to do with the refusal of the Persian Government. They had also constantly been trying to inaugurate a service between London and Prague, and the difficulty at present was not one raised by the German Government, but a money difficulty. Referring to Iraq, he said the alarmist reports coming from Basra and Mecca and other centres of the Middle East did not give a correct view of the situation. We were not at war with Ibn Saud, but were engaged in the necessary duty of repelling murderous and plundering marauders who had crossed the Iraq frontier, and there was no atrocity which they did not commit, not only against the male population, but against the women and children as well. The inhabitants of Transjordania or Iraq were not the first offenders.

The amendment was defeated by 187 to 75. The next motion dealing with Works, Buildings, and Lands. Questions put, and agreed to.

The debate was continued on March 20. On the above Report "A,"

Lieut.-Comdr. Kenworthy formally moved to reducet he Vote by 100 men.

Capt. Cazalet (Chippenham—U.) said that compared with any other form of armament, aircraft was relatively economical, as had been shown by certain campaigns in the East. He would like to pay tribute to the work which the Air Force had done in Iraq, and he sincerely believed that if we had tried to carry out our mandate to preserve law and order in that country by any other means except through the Air Force it would have cost us many additional millions of money and many additional lives as well. He asked the Secretary of State for further information regarding the power of aircraft to attack naval craft. Concerning commercial aviation, he thought it was quite clear that this would probably never be a financial success in this country owing to the shortness of distances between important places. Commercial aviation was, however, of vital importance in the development of certain parts of the Empire.

Capt. Guest (Bristol, N., Lib.), said he wished to refer more especially to civil aviation. When one considered that after six years (from the time when he became Secretary of State for Air) the total amount spent in this country on civil aviation was only £260,000 a year, it seemed that there must be some truth in the saying that there appeared to be no civil aviation policy at all. From a study of the Estimates during the last nine or ten years, we found that this country had not spent more than £1,750,000 on civil aviation. If great policies were boiling in the minds of the Director-General of Civil Aviation and the Secretary of State for Air, and if the decisions of the Chancellor of the Exchequer stopped their plans, then, when the House grasped how pathetically small was our effort in comparison with those of other countries, it would come to the aid of the Secretary of State. The mileage flown in Germany last year was nearly 4,000,000 miles, in France 3,200,000 miles, and in Great Britain only 800,000 miles. There was another figure which told more of the way in which the air sense of other countries was going ahead of our own country. The number of passengers carried in German commercial aeroplanes last year was 187,000; the figure here was only 22,000 or 25,000. The disparity was too great. He was satisfied that something ought to be done if one judged the matter of policy only by those figures. If they did not subsidise civil aviation, they would allow other countries which did subsidise to get so far ahead that they would not be able to catch up. There were other considerations which he thought were fundamental to the formation of a real national policy of civil aviation. The first was that the success of the activities of any company in far-off lands like Australia or East Africa should not be gauged by the percentage of profits; it must be gauged by the gradual development of settlers and of settlers' needs being met by this means of rapid transport. Another consideration, of rather a different nature—we were a very small country and were not on the way to anywhere in particular. It was true that wealth had accumulated in London, but from the point of view of rapid transport for the Empire, perhaps it would be better if our Croydon were in Egypt and if some more central spot were chosen from which this great aerial activity could take place. One other point was that we were obviously, or should be, a seaplane power. Every time that anybody in an aeroplane crossed the ocean, if he could not see across it, he undoubtedly ran a considerable risk. He did not maintain that a boat or a seaplane was an absolute safeguard, but he was perfectly convinced that if the attempts to cross the Atlantic had been made in any boat sufficiently powerful and large to carry the petrol required, they would have been made with greater safety than had been the case up to now. Shipping must be linked up with air service, and the only form of air service which could be linked up with shipping was the seaplane. He would like to see at Southampton a seaplane base run under the auspices of the Civil Aviation Department.

Col. Woodcock (Everton, U.), congratulated the Secretary of State on the wonderful progress he had made with the Air Force and the great efficiency to which he had brought it. He thought, however, that we wanted a stronger force to look after the financial side of the Air Ministry. Civil aviation, he said, ought to be extended in this country at a far more rapid rate than it was. He was, however, very grateful for the sympathetic and practical support the Secretary of State was giving to the light aeroplane clubs, which were doing splendid work.

Rear-Admiral Sueter (Hertford, U.), after replying to criticisms raised by Mr. Rose in connection with airships, again urged the Air Ministry to take action regarding Atlantic flights.

Lieut.-Col. Moore-Brabazon (Chatham, U.), said they had had one of the worst weeks he could remember in the history of aviation, but hoped that they were not going to lay down absurd rules as to what people might or might not do. He hoped Sir Samuel Hoare was going to tell them what was going to be done regarding seaplanes and the attempts on the world's speed record. In connection with Reserve Squadrons, if the Secretary of State was going to increase them and ask people to join them, their life must be made a little more comfortable. Many join because of their love of the air and machinery; will the Secretary of State get them into the air, as many of them are always on the ground and never get a chance of going up.

Sir Samuel Hoare, replying to the debate, thanked the members for the manner in which they had approached the discussion. It had been a very valuable discussion, and the many suggestions he had received would receive careful attention. He was not so self-satisfied as to think that his Department and everything connected with it was perfect. Regarding civil aviation, he was grateful to Capt. Guest for having dealt with the question in such a sympathetic way. The trouble with civil aviation was the trouble with many other things at present—the trouble of money. He wished that he had more money for civil aviation purposes. He had taken careful note of the fact that every hon. member who had dealt with the question during the debate had declared that the Civil Aviation Vote ought to be higher than it is at present, and he would not fail to bring that rather rare unanimity to the attention of his colleagues. He could not help thinking that Capt. Guest had painted the picture a little bit too black. From the point of view of the length of our civil air routes we might compare unfavourably with certain other foreign countries, but from the point of view of reliability and of economy of administration we were quite definitely ahead of the civil aviation in any other part of the world. Our routes might not extend as widely as the routes of certain other countries, but he believed that if the figures were analysed it would be found that, year by year, we were making better progress than they in making civil aviation self-supporting and in bringing nearer the time when it would no longer be dependent on Government subsidies. The cost per ton-mile had, during the last three years, fallen from 4s. 3d. to 1s. 10d. The reliability of the British service now reached 96 per cent., compared with 75 per cent. four years ago. The latest civil air service, between Cairo and Basra, had been running with a reliability of 100 per cent. Although our services were in distance smaller than those of other countries we were carrying three-quarters of the passengers between London and Paris, and year after year mails, freights and passengers were going steadily up. He had included in the Estimates a sum with which he hoped to make a beginning with the route between London and India. It was not very large, as the details still had to be worked out. It was the first instalment of a bigger and more ambitious programme, the immediate objective of which would be to make a weekly service between London, Karachi and Calcutta. He had been asked about the details of the route, and he would lay a White Paper as soon as the details were finally settled. He thought there would be a substantial demand for the carriage of mails over this route, and that when it was found to be sure and safe a demand for passengers would follow. Capt. Guest had suggested that by working the short service flying officers in with the work of the Imperial Airways Company they might help aviation and provide the Air Force at the same time with a sufficiency of young officers and a sufficiency of Reserve officers. He was not quite clear what the right hon. gentleman had in his mind, but as at present advised he saw serious difficulties in the way of the suggestions he had made. He was, however, willing to go further into the matter with him. He wondered whether it was really wise to identify too closely military and civil aviation. In the future the civil machine was likely to become more and more distinct from the military machine, and he was not sure that it was desirable to embark on a policy which would militarise our civil aviation.

Regarding the question as to who would be in control of an operation in which merchant shipping was being attacked from the air. The answer to this depended on the particular circumstances of the operation. If it were on the high seas it would be a naval operation; it might conceivably occur in the narrow seas within reach of land, when the operation would principally be an air operation.

With regard to airships, the Ministry's action was an experiment, and a difficult one. They had, so far as was humanly possible, tested the claims of designers, introduced new materials, drawn in outside scientists, studied weather conditions as they had never been studied before, and studied also the lessons of the past. The Ministry believed that after this long period of experimental research they were starting upon an experiment with a better chance of success than ever before. He asked members to be patient for a little longer. The two airships would be completed this year, and should be undergoing their flying tests. Members should judge the success of the programme by the actual results as shown in the next few years.

Concerning the question of disarmament, certain members had put this dilemma to the House—that we should either have an Air Force strong enough to drive any possible enemy force from the air or no Air Force at all. He did not agree. The aim of the Air Ministry was to build up a force so strong as to make the risk of attack so great that the enemy would not dare to make it. He did not think that the Air Force was yet sufficiently strong for all purposes. The Committee of Imperial Defence had come to the conclusion that the minimum Air Force was 52 squadrons. At present the strength was between 30 and 40 squadrons, and he should not be satisfied until he saw the programme of 52 squadrons completed. As to Transatlantic flights, his answer was very much of the kind that had been given by Col. Moore-Brabazon. He believed that it would be unwise for a Government Department to obtain legislative powers to prevent flights of that kind.

The amendment was defeated by 217 votes to 90—majority, 127—and the resolution was agreed to. The Report of the remaining Votes was also agreed with.

Navy Estimates: The Fleet Air Arm.

THE First Lord of the Admiralty, Mr. Bridgeman, speaking in the House of Commons (on March 15) on the Navy Estimates, made the following reference to the Fleet Air Arm. He said that as far as additions to expenditure were concerned he did not know that he need call attention to anything special, except perhaps the addition of £198,000 for the Fleet Air Arm, which was to provide a new type of aircraft to be carried in the "Glorious" when she was ready for them.

AIRISMS FROM THE FOUR WINDS.

African Service Flight

THE three R.A.F. Fairey IIIF machines engaged on the annual service flight from Cairo to Cape Town and back, reached Pretoria on March 21 after making a forced landing at Polgietersrust owing to one of the machines developing an oil leakage. On March 23 they flew to Bloemfontein and arrived at Cape Town on March 25, thus completing the outward flight, which commenced from Heliopolis on March 1. Four machines had started but one crashed at Ndola on March 16, and was left behind. The officer in command of the flight is Air Vice-Marshal Webb-Bowen. He was in the crashed machine, but was uninjured.

French Flight to Africa

M. MAULER, the French pilot, is flying from Paris to Cape Town. He is apparently following the western route in preference to the more popular eastern route, for he landed at Dakar, West Africa, on March 22.

"Red Rose" Continues

AFTER landing safely at Port Darwin in their Avro "Avian," Capt. Lancaster and Mrs. Keith Miller remained there for a few days and then flew on to Newcastle Waters on March 22 and Camooweal on March 23. They went on to Toowoomba on March 26. At the end of this week they expect to reach Brisbane.

By Light Aeroplane to the Cape

AFTER reaching Cape Town alone in her D.H. "Moth," Lady Bailey was banned from crossing the danger area in the Southern Sudan alone. This ban was enforced by the Governor-General of the Sudan on March 22. The Johannesburg *Star* telegraphed Flight-Lt. Bentley, who is flying towards Cairo in his D.H. "Moth" with his wife, offering to compensate him for any alteration to his plans if he would provide the necessary escort for Lady Bailey. The *Star* also telegraphed Lady Bailey for her acceptance of such an offer, which was given. Flight-Lieut. Bentley also agreed to the request, and stated that his wife would wait for him at Khartoum, from where he would continue his flight to England. He will probably join Lady Bailey, who arrived at Luxor on March 27, at Khartoum.

The Arctic Flight

CAPT. GEORGE WILKINS and his pilot, Lieut. B. Nielson, flew the first stage of their projected flight over the Arctic when they recently arrived at Point Barrow, on the north-west coast of Alaska, from Fairbanks, Alaska.

Italian Polar Flight

GENERAL NOBILE'S airship, the "Italia," flew non-stop for 22 hours on March 20-21. With the general and a crew, it left Rome and reached Milan *via* Genoa and Turin.

Atlantic Air Service Proposal

THE well-known French air ace, Capt. René Fonck, is completing plans for an air service between Europe and America *via* the Azores. He stated that mail would be conveyed first and that after two years' experience passengers would be flown across. New York and Paris would be the termini. Experiments with floating islands placed at intervals of approximately 325 miles are likely to be made. The capital of £4,000,000 will be subscribed by America and France, and the company will be named the Franco-American Airways Corporation. The mail service may be in operation this year.

German Atlantic Attempt

CAPT. H. KOEHL, a Lufthansa pilot with considerable flying experience, landed at Baldonnell aerodrome on March 26 at 4.30 p.m. in a Junkers monoplane, after leaving Berlin at 8.20 a.m. With him as passenger was Baron von Hühnefeld and as mechanic, Herr Spindler. They are to attempt to fly the Atlantic from Ireland as soon as the weather is favourable. Their venture is purely private, and financed by the Baron. The departure from Berlin was secret owing to their fear of opposition from the German Government and the opposing opinion of the public, which has been disturbed by recent Atlantic disasters. Last summer Capt. Koehl was one of the pilots who made a futile attack on the Atlantic from Germany, having to turn back when 100 miles beyond the Irish coast owing to bad conditions. He has definitely left the service of Lufthansa through differences concerning his present flight. They refused to support him on the grounds that three-engined seaplanes should be used on an ocean crossing. It is the company's intention to organise their own flight, using a Rohrbach flying-boat, within the next few months. Capt. Koehl's machine is the one he used for his previous effort, and has been given the original name, "Bremen." It is of the J.33 type, fitted with a single Junkers 5 engine of 280-310 h.p.

Forced Landing in Alps

CAPT. L. HOPE, the air-taxi pilot and winner of last year's King's Cup Race, made a recent forced landing in the Alps at 8,000 ft. He was flying a D.H. "Moth" and his passenger was Count Franco Mazzotti, the racing motorist. The machine sank in the snow up to the bottom wing, and the two airmen were rescued with lifelines from the mountain top by Alpine Fascisti, who had seen the landing. Returning to the mountain, the next morning, they put the machine in sleighs and hauled to a plateau at 5,000 ft. Skis were then fitted with boxes on them and a perilous ascent was made towards a precipice over which the machine lifted just in time, shedding its temporary footwear into the ravine. Italy was the destination of Capt. Hope but his passenger did not occompany him in the machine but travelled by road to Turin.

Cape Town-Johannesburg Service

LT.-COL. HENDERSON has chosen a three-engined German Junkers all-metal monoplane for the Cape Town-Johannesburg air service, which he will open in November next. In answer to criticisms of his choice, he stated that finance was necessarily the deciding issue, and he did not know of any British machine suitable for his purpose which could be supplied at the German price. Col. Henderson leaves for England next month.

Lindbergh again Honoured

PRESIDENT COOLIDGE presented Col. Lindbergh with the Congressional Medal recently. This is the highest honour the Government can bestow. The ceremony was attended by members of the Cabinet, officials and Congressmen, many of whom occupied Col. Lindbergh three days taking joy-rides with him. Col. Lindbergh is reported to have stated that since his Atlantic flight last year, he has made £100,000 in aviation through giving his services in various flying capacities.

Avro "Avian" for Air Survey

MR. F. P. RAYNHAM, the pioneer pilot, has purchased an Avro "Avian" for air survey work in connection with the Air Survey Company of London and Rangoon.

Director of Civil Aviation flies to Berlin

SIR SEFTON BRANCKER flew to Berlin from London on March 26 to take part in the Twenty-sixth International Air Conference, which opened at the Ministry of Communications on March 27.

Twenty Years Ago!

Extract from "The Auto." (Precursor of "Flight"), March 28, 1908.

"*Mr. Henry Farman Makes a New Record.*—After having made a very satisfactory flight of about a mile and a half over a circular course on Friday of last week, Mr. Farman summoned the Aero Club Committee to witness further attempts on Saturday. Two posts, 550 yards apart, were erected, and outside these the Farman aeroplane circled twice in succession. The official distance is given as 2,004·8 metres, and the official time as 3 mins. 31 sec.; it is estimated, however, that Mr. Farman must have altogether flown over 4 kiloms from start to finish. *Two Passengers on the Delagrange.*—Not the least gratifying in this conquest of the air, is the good fellowship existing between the successful and epoch-making rivals. After having successfully achieved a circular flight of over a mile in length, on Saturday, March 21, M. Delagrange remounted his machine, and Mr. Henry Farman joined him. M. Delagrange then succeeded in accomplishing a short flight with his passenger. This is the first recorded occasion on which a heavier-than-air machine has carried two persons, and will doubtless be of historic interest as the initial essay into that other and wider sphere which it is hoped the flying machine may ultimately conquer."

THE ROYAL AIR FORCE

London Gazette, March 20, 1928

General Duties Branch

The following Pilot Officers are promoted to rank of Flying Officer with effect from the dates indicated :—J. H. E. Jones (June 18, 1927) ; J. H. Pool (October 11, 1927) ; G. H. Godwin (November 7, 1927) ; F. L. Lawrence (November 8, 1927) ; C. H. A. Colman, H. F. Gower, W. E. W. Grieve, S. R. Sherman (January 10) ; R. C. Edwards, R. G. Hennessy, D.S.O., M.C., A. O. Moore (January 14) ; T. M. Abraham G. M. Buxton, R. J. Carvell, L. S. Hill, J. W. Pease (January 17) ; E. S. Finch (January 30).

The following Pilot Officers on probation are confirmed in rank :—A. O. Moore (July 14, 1927) ; B. G. Farrow (July 17, 1927) P. F. G. Bradley, G. W. Monk, G. N. S. Lane, S. Hatton, R. C. Hancock, A. G. C. Somerhough, J. E. Stuart-Lyon, R. David (March 19).

Flying Officer H. L. Patch is placed on half-pay list, scale B, March 12 to 23, 1928, inclusive ; Flight-Lieut. J. A. Glen, D.S.C., is placed on retired list at his own request (March 12) ; Flying Officer A. H. C. A. Rawson is transferred to Reserve, Class A (March 8) ; Flying Officer G. W. Higgs resigns his short-service commn. (March 21) ; C. Campbell, Lieut., R.N., Flying Officer, R.A.F., relinquishes his temp. commn. on resigning his commission in Royal Navy (March 7) ; Flying Officer W. F. A. Preston (Lieut., R.A.—seconded) relinquishes his temp. commn. on return to Army duty (March 14).

Stores Branch

The following Flying Officers are granted permanent commns. in this rank with effect from May 21, 1927, on completion of probationary service :—G. J. Gaynor, F. E. R. Dixon, M.C.

Medical Branch

The following Flights Lieuts. are granted permanent commns. in this rank (March 21) :—J. M. Wilder, L. I. Hyder. Temp. Capt. J. M. Jamie (Dental Surgeon, General List), is granted temp. commn. as Flight Lieut. on attachment to R.A.F. (March 1) ; Flight Lieut. C. T. Hastings (Capt., Army Dental Corps) relinquishes his temp. commn. on return to Army duty (March 1).

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

G. A. Worth is granted a commn. in Special Reserve as Pilot Officer on probation (March 12) ; Pilot Officer E. L. Purdy, M.C., is promoted to rank of Flying Officer (March 16). The following Pilot Officers on probation are confirmed in rank :—J. M. H. Hoare (March 14) ; B. B. F. Russell (March 17).

The following Flying Officers are transferred from Class A to Class C (March 20) :—G. Colledge, W. E. Gandell, M.M. Flying Officer J. Sewell is transferred from Class B to Class C (February 5).

The following Flying Officers relinquish their commns. on completion of service :—J. G. Webster (September 16, 1927) ; M. H. Findlay, D.S.C., D.F.C. (January 13) ; A. Y. Paton, D.C.M. (March 11) ; E. Crewdson, M.C., H. S. Howard, A. G. Squire (March 18). The following resign their commns. (January 15) :—Flight-Lieut. A. F. Ingram, Flight-Lieut. A. E. Reynolds, Flying Officer B. A. Davy, Flying Officer J. T. O'Brien-Saint.

AUXILIARY AIR FORCE

General Duties Branch

No. 602 City of Glasgow (Bombing) Squadron. The followkng to be Flying Officer :—J. S. Lennox (March 1).

No. 603 City of Edinburgh (Bombing) Squadron. The following Pilot Officer to be Flying Officer :—L. J. Blake (January 24).

Princess Mary's R.A.F. Nursing Service

Staff Nurse Miss Nora Meikle is promoted to rank of Sister (October 20, 1927).

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified :—

General Duties Branch

Squadron Leaders : D. G. Donald, D.F.C., A.F.C., to R.A.F. Training Base, Leuchars, 1.3.28. C. E. W. Foster, to Schl. of Tech. Training (Men), Manston, 5.3.28. F Workman, M.C., to No. 3 Flying Training Schl., (Cadre), Spittlegate, 1.4.28. C. H. Nicholas, D.F.C., A.F.C., to No. 20 Sqdn., India, 17.3.28. H. Stewart, to No. 9 Sqdn., Manston, 15.3.28.

Flight Lieutenants : R. A. George, M.C., to remain at H.Q., Cranwell, instead of to R.A.F. Depot, Uxbridge, as previously notified. J. Duncan, to No. 1 Schl. of Tech. Training (Apprentices), Halton, 16.3.28. A. R. M. Richards, A.F.C., to H.Q., Aden Command, 16.3.28. F. C. Marsh, to No. 2 Wing H.Q., India, 28.2.28. A. R. Prendergast, to No. 27 Sqdn., India, 21.2.28. R. K. Emerson, to Station H.Q., Heliopolis, 1.3.28. J. D. S. Denholm, to R.A.F. Practice Camp, Sutton Bridge, 28.3.28. L. de V. Chisman, to R.A.F. Station, Upper Heyford, 26.3.28.

Flying Officers : A. L. Ottway, to No. 41 Sqdn., Northolt, 12.3.28. V. C. Taylor, to No. 19 Sqdn., Duxford, 12.3.28. W. A. Andrews, to No. 23 Sqdn., Kenley, 12.3.28. L. G. Martin, to Schl. of Naval Co-operation, Lee-on-Solent, 19.3.28. C. G. C. Sullivan, to Station H.Q. and Storage Section, Andover, 2.4.28. C. H. G. Brembridge, to No. 2 Flying Training Schl., Digby, 16.3.28. F. B. G. Walker, to Night Flying Flight, Biggin Hill, 5.3.28. D. G. K. Walker No. 26 Sqdn., Catterick, 13.1.28. E. M. Thompson, to No. 403 Flight, 2.1.28. D. J. Harrison, to No. 423 Flight, 17.3.28.

Pilot Officers : R. Y. Bootes, A. M. Cowell, A. J. P. Groom, A. Haywood, A. D. Jaffe, R. V. Redpath, R. E. S. M. Vinning, and A. H. Westwood, to No. 1 Flying Training Schl., Netheravon, 13.3.28. A. McKee, to Aircraft Depot, India, 11.2.28. A. R. Grenfell, to No. 5 Flying Training Schl., Sealand, 30.3.28. G. F. Simond, to R.A.F. Depot, Uxbridge, on appointment to a Permanent Commn., 16.3.28.

The under-mentioned Pilot Officers are posted to the R.A.F. Depot, Uxbridge, on appointment to Short-Service Commissions, with effect from 16.3.28 :—J. A. G. Baker, H. M. S. Barnard, M. I. Barnett, J. Beaumont, F. A. R. Bishop, B. S. Bramble, W. E. Catling, R. Chadwick, R. D. Cotton, W. J. Crisham, R. S. Darbyshire, F. P. Donovan, H. J. Forster, F. C. G. Freeman, O. V. Garrett, O. I. Gilson, E. S. Greenwood, A. N. E. Hall, C. P. Hanlon, J. A. Harris, B. W. C. E. Hartwell, E. G. Hitchins, T. R. Hope, H. T. Lines, V. B. Lintott, J. H. Lock, E. D. Mills, R. Mountain, V. H. Nicolay, J. S. Pole, G. E. F. Proctor, J. B. W. Pugh, C. H. Robbins, N. X. Sheldrick, L. H. Snelling, F. H. Taylor, D. Timms, J. G. Walling, R. F. Williams, and R. F. A. W. Williams.

Stores Branch

Squadron Leader W. J. King, D.C.M., to No. 1 Schl. of Tech. Training (Apprentices), Halton, 26.3.28.

Flying Officer C. W. Rugg, to H.M.S. " Argus," 20.2.28.

Accountant Branch

Flight Lieutenants : E. V. Humphrey, to Station H.Q., Heliopolis, 1.3.28. W. R. Westcombe, to H.Q., Middle East, 17.3.28.

Medical Branch

Squadron Leaders : R. J. Aherne, M.C., to H.Q., Middle East, 9.3.28. P. H. Young, M.B., to H.Q., Iraq, 9.3.28.

Flight Lieutenant R. Boog-Watson, M.B., D.P.H., to R.A.F. Station, Upavon, 30.3.28.

Flying Officers : J. Twohill, M.B., to R.A.F. Training Base, Leuchars, 20.3.28. G. T. O'Brien, to R.A.F. Practice Camp, Sutton Bridge, 29.3.28. M. Clancy, to R.A.F. Practice Camp, Weston Zoyland, 29.3.28. G. W. J. Williams, to R.A.F. Practice Camp, North Coates Fitties, 29.3.28. L. Freeman, G. W. McAleer, M.B., E. P. Carroll, J. F. McGovern, M.B., and W. Heron, M.B., to H.Q., Iraq, 9.3.28.

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RUGBY FOOTBALL SERVICES TOURNAMENT

Royal Air Force versus Army*

THE previous results of this year's Services Tournament were :—

Royal Navy beat Royal Air Force	5—0
Army beat Royal Navy	11—5

Therefore, on paper, the Army should have been just 11 points better than the Royal Air Force, and they actually won by a margin of 12 points. On paper everything appears to have worked out according to plan.

Yet, paper results may be as fallacious as paper prophecies ; and in this case the margin by which the Army won their final match gives very little indication of the run of the game. But we may revert to paper again for a moment and examine the teams on the programme. The Army had an international full back, three international three-quarters, one international half, and two international forwards. Against this cluster of talent in all lines, the R.A.F. could only put into the field one international half-back and one international forward. All the probabilities pointed to the Army assuming a complete mastery of the game from the start, and proceeding to pile up scores considerably in excess of the 11 points to which their record *in the tournament had entitled them*. This, however, was what did *not* happen. For a good three-quarters of the game the Air Force was the aggressive side. They dominated it completely up to the half-time whistle, and had quite an equal share of attacking in the second half. But a temporary lapse on the Air Force let the Army start the scoring with the result that for a while the Army were completely on top and made victory certain. Too late, the Air Force came again and scored twice, and then right at the end they broke down again, and let the Army finish in the ascendant.

For nearly the whole of the game the outstanding features of the play were the excellence and predominance of the Air Force forwards and the Air Force halves. The Army forwards were beaten completely in the tight scrums and were outplayed also in the loose. The Air Force forwards got the ball and heeled with almost monotonous regularity and precision. Russell invariably picked up in his nippiest fashion, and sent excellent passes out to Odbert, who invariably took them, and frequently passed them on to the three-quarters. The latter handled with accuracy. But at that point the R.A.F. excellence came to a full stop. The centre three-quarters, Pott and Hodder, could give and take passes, but they could not or would not run straight. They absolutely distrusted their own powers of breaking through the Army centre. Time and again the ball passed along the R.A.F. line without the gain of a foot, until it reached one or other of the wing men. Coote and Bremridge had the root of the matter in them. They went hard and tried to run round their opposite numbers, but they lacked the speed to do so, for which they are not to be blamed. After a passing bout right across the field, with no advance made, the defence is always in a stronger tactical position than the attack. Had the R.A.F. centres been real thrusters, a comfortable tale of scores in the first-half would have been inevitable. For the Army centre was not impregnable. Odbert frequently penetrated it, but he was always allowed to go on alone, and no one backed him up to take his pass. Pott and Hodder did great work in defence, and towards the end Pott scored a good try. But the lack of the " will to victory " in the centre of the three-quarter line was one of the causes of the R.A.F. failure to develop their advantages. The other cause was the full back. Last year, Hale-Munro was a good full-back, but in both Service matches this year he has been badly off his game in fielding, kicking, and tackling. It often happens that, when a player is below form, bad luck comes in the train of bad management, and last Saturday the ball would never bounce kindly for Hale-Munro.

And what of the paper brilliance of the Army In the first half it was only apparent in Rees the full back. In the three-quarter line, Palmer (an excellent wing three-quarter) was playing in the centre without the faintest conception of the duties of a centre " three." Aslett and Devitt were quite off their game ; and Bryan, who alone of the four had not received an international cap, was easily the best of them. In the second half, Devitt and Palmer changed places with manifest advantage to the line. Until that was done, the Army line was extremely ineffective.

At half-back the inferiority of the Army to the Air Force was even more astonishing. Arthur Young was strangely quiescent until near the end of the game. Of course, his forwards did not give him much chance, for they very rarely got the ball. He did not seem to think it worth while to try to interfere with Russell ; and his passing, when he had any to do, was more erratically " Youngish " than ever. But Young's value to a side is not that he is a great scrum-half, but that he is a brilliant free-lance player. Of his almost uncanny skill in seizing opportunities to commence an attack he gave hardly any evidence until near the end of the game. Then he suddenly became the Arthur Young who is the darling of England and the terror of her rivals.

This match, being mainly a forward game, does not lend itself to narrative so much as to reflections and moralisings. The Air Force first defended

* Played at Twickenham on Saturday, March 24, and won by the Army by 18 points (three goals and 1 try), to 6 points (two tries).

the northern goal, and very early their forwards showed their easy mastery in the scrums and line-outs. One of the first incidents to notice was when Russell dribbled up to Rees, and when the latter picked up, Russell charged down his kick. In the first 10 minutes Guardsman Gibbons was hurt and had to be carried off the field, but before this happened the Air Force forwards had clearly proved their superiority. Chick and Christie were constantly prominent in the loose. The brothers Beamish were not conspicuous in the same way, and evidently remained right in the thick of things. Great amusement was caused when a kick by Hale-Munro knocked a spectator's hat off. The said spectator cannot have been following the game closely, and must have been woken up with a nasty jar. A good tackle of Devitt by Hodder deserves mention.

After 25 minutes' play Bremridge got over on the right, but in doing so knocked down the corner flag, and series of scrums on the Army line followed. Rees cleared by kicking into the hands of Hale-Munro and gaining handsomely on the exchange. The Air Force came back, and Odbert made the first of his brilliant breaks through the centre, but he was tackled with the ball. A few minutes later he again wormed his way right through, and an Air Force score seemed certain, but his pass went forward. Half-time arrived with no scoring, and the general feeling that Army had been very lucky to escape.

For the first few minutes of the second half the Air Force maintained their attacks. Odbert made a very good run, and when Devitt cleared, Russell sent the ball back again.

Then suddenly Arthur Young woke up. In his own peculiar style he appeared from nowhere with the ball under his arm and ran right down the field, weaving a tortuous way through the Air Force defenders. Then he gave a scoring pass to Bryan, who romped over the line. Rees converted and the Army were somewhat surprisingly 5 points to the good

This infused new spirit into the whole Army team, and the Air Force pressure relaxed for a fatal 10 minutes. Chick once relieved matters by a dribble, but a free kick brought the Army back to their opponents' 25 line. Then, from about half-way Bryan started a lone-hand dribble, passed everybody in turn, and scored himself in the left-hand corner. This should never have been allowed. The kick failed, but the Army were now 8 points up and began to look like winning.

But the Air Force forwards woke up again and rushed the ball back. From a free kick Coote had a shot at goal, but did not carry far enough. The ball was passed well out to the left, but Bremridge was pulled down by a faster man than he. A maul followed, and finally George Beamish fell over the Army line and scored a try for the Air Force.

Why, oh ! why was this not done in the first half of the game ? The story might have had a different ending.

But the Army were roused to renewed efforts. They had discovered that they could score, and they decided to do it again. Young started another movement, and passed to Devitt. He fed Bryan, who put in the most telling part of the work, and finally Aslett scored between the posts. The Army well deserved this score, which Rees duly converted. The Air Force had no power to recover from the position 13 to 3.

Nevertheless, they, like their opponents, seemed roused by reverses. Russell opened up to the right, and Coote followed up a punt and made some ground. Devitt got the ball, but lost his head and ran round in circles, Coote dribbled on and tackled Rees, and finally Pott just scrambled over the line for a try for which the credit goes to the whole Air Force side, and notably to Coote. The latter, however, could not bring off a difficult place kick. The score was now 13 -6, and that would have been about right for the turn which the play had taken.

The worst, however, was yet to come. For once the Army forwards had the best of matters in a loose rush, and Townend picked up and scored after running some distance. The Air Force should not have allowed this. Rees kicked the goal, and then the whistle blew for time. No scoring in the first half, and six scores in the second half, made a very unusual match. Teams (from programme).

F. A. DE V. R.

The Teams

The Army.—*Full back* : *Guardsman T. E. Rees (1st Bn. Welsh Guards). *Three-quarters* : Right wing, *Lieut. Sir T. G. Devitt, Bart. (2nd Bn. Seaforth Highlanders) ; right centre, *Lieut. A. R. Aslett (Capt.) (1st Bn. King's Own Royal Regt.) ; left centre, *Lieut. G. V. Palmer (Queen's Royal Regt.) ; left wing, Lieut. G. J. Bryan (Royal Engineers). *Half-backs* : stand-off, 2nd Lieut. J. R. Cole (2nd Bn. The Loyal Regt.) ; scrum, *Lieut. A. T. Young (Royal Tank Corps). *Forwards* : Sergt. D. Jones (1st Bn. South Wales Borderers), Lance-Corpl. W. A. Morton (1st Bn. King's Own Royal Regt.), Lance-Corpl. G. Townend (1st Bn. Duke of Wellington's Regt.), *Lieut. C. K. T. Faithfull (Duke of Wellington's Regt.), Lieut. G. E. R. Bastin (Royal Artillery), *Lieut. W. F. Browne (1st Bn. Duke of Wellington's Regt.), Lieut. H. H. C. Withers (Royal Engineers), Guardsman P. E. Gibbons (1st Bn. Welsh Guards).

Royal Air Force.—*Full back* : F.O. T. A. Hale-Munro (No. 29 Sqdrn., Duxford). *Three-quarters* : right wing, Aircraft Apprentice P. B. Coote (R.A.F., Halton) ; right centre, P.O., J. R. H. Pott (No. 111 Squdn., Andover); left centre, F.O. F. S. Hodder (No. 13 Squdn., Andover), left wing, F.O. C. H. G. Bremridge (No. 2 Flying Training School, Digby). *Half-backs* : stand-off, *F.O. R. V. M. Odbert (Capt.) (No. 58 Sqdn., Worthy Down ; scrum, Sqdn.-Ldr. J. C. Russell, D.S.O. (Air Ministry). *Forwards* : F.O, C. J. S. O'Malley (R.A.F. Hospital, Halton), Flight-Sergt G. F. Cockell (R.A.F. Depot, Henlow), *F.O. F. V. Beamish (R.A.F. Cadet College, Cranwell), P.O. H. A. Constantine (No. 56 Sqdn., North Weald), Flight-Lieut. C. D. Adams (R.A.F., Halton), Flight Lieut. J. S Chick, M.C., A.F.C. (Central Flying School, Wittering), Corpl. M. G. Christie (R.A.F. Depot, Shrewsbury).

* International.

IN PARLIAMENT

Bombing Experiments

MR. BRIDGEMAN, on March 21, in reply to Lieut.-Comm. Kenworthy, said a number of experiments to ascertain the effect on a ship's structure and fittings of bombs exploding below water have been carried out by the Admiralty, and recent design in under-water protection is based on information obtained from these experiments. Research is still being continued on this subject on scale models and special targets. It is not in the public interest that the details of the various experiments carried out and in contemplation should be published. All the published accounts of experiments made by the American Government have been received and noted by the Admiralty ; in general they are in accord with the British Admiralty experiments.

Aviation and High-speed Flights

SIR S. HOARE, in reply to Capt. Crookshank, said that high-speed flights were of very great practical use. They had found that high-speed trials had resulted in distinct advances in the matter of engines, in the design of aircraft, and in the design of floats.

Sir S. Hoare, in reply to Mr. Lawson (for Mr. Bromley), said Flight-Lieut. Kinkead was himself the officer in charge of the high-speed flying section of the Marine Aircraft Experimental Establishment, and as such was responsible for the arrangements for the attempt.

In reply to Mr. Day he said there was no intention of abandoning the high-speed research work carried out by his Department.

COMPANY DOINGS

Handley Page, Ltd.

THE Ordinary General Meeting of Handley Page, Ltd., was held on March 21. The results of the year's working showed a credit balance of £31,638 after placing to reserve £15,000 and writing off £3,239 for depreciation. The directors considered the results quite satisfactory, and recommended that a final dividend of 5 per cent. be paid on the preference shares, making 10 per cent. for the year, and that the remaining balance of £11,723 be carried forward to the next year's accounts. In his remarks on the slotted wing development Mr. Handley Page said that licences had already been granted in France, the United States and Germany, and negotiations were proceeding in Japan, Italy, Belgium, Sweden and Spain. The ultimate sums which they would receive would depend very largely on the use made of the device, and this was only just commencing. New devices might replace the present design. They might possibly have to face cases of infringement and possibly heavy expenses in fighting such actions. He would not have them think that now the great value of their patents had been demonstrated there would be immediate realisation of large sums for those patents

Concerning Air Ministry contracts, Mr. Handley Page said that with aircraft work depending very largely on Government orders placed on a yearly basis only, it was exceedingly difficult to organise operations to obtain cheap production and reduced prices. It would be more satisfactory to all concerned—and he would recommend it to the notice of those in authority who dealt with such matters—if the construction programme ranged over at least three years, so that, with a period of settled output ahead of them, economies could be affected, a reduction in cost of manufacture made, with, simultaneously, a higher wage to the men employed. Last year he had occasion to refer to the company's interest in civil aviation, and to express the regret that there was not great co-operation between manufacturing and operational interests. The company, through its subsidiary, Handley Page Transport, Ltd., was one of the two companies responsible for inaugurating civil aviation in this country and starting air lines to the Continent, Paris, Brussels and Amsterdam. Without its financial support British civil aviation would not have carried on during the unsubsidised years of 1919 and 1920.

When in 1923 and 1924 they decided to merge in the monopoly undertaking which had since carried on British civil air transport, into this fusion, they went on the understanding that their interests in civil aviation would be kept up and their representation in the company continued.

That co-operation had not, however, been allowed them. He felt that it was a matter of regret that it was so, not only for the interests of the company but for the interests of aviation development as a whole.

R.AE.S. AND INST.AE.E.

(Official Notice)

ON Thursday, April 12, Dr. Hele-Shaw and Mr. T. E. Beacham will give a lecture before the Royal Aëronautical Society at the Royal Society of Arts, 18, John Street, Adelphi, on the "Variable Pitch Airscrew."

The problem of the design of a variable pitch airscrew is one which has been engaging the attention of airscrew experts for many years. The solution presents many mechanical difficulties, but the resultant advantages of obtaining a solution are great enough to have warranted the amount of time and thought that have been given to the problem. Many schemes have been tried and have failed. The variable pitch airscrew designed by Dr. Hele-Shaw and Mr. T. E. Beacham has been developed and tested with the help of the Gloster Aircraft Company, and in their lecture the principle of the airscrew will not only be described in detail, but the results of successful flying tests will be given. The lecture will be fully illustrated.

J. LAURENCE PRITCHARD,
Secretary

AERONAUTICAL PATENT SPECIFICATIONS

(*Abbreviations* : Cyl. = cylinder ; i.c. = internal combustion ; m. = motor. The numbers in brackets are those under which the Specifications will be printed and abridged, etc.)

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